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**NATIONAL INSTITUTE OF MENTAL HEALTH  
& NEURO SCIENCES  
BANGALORE**

**EPIDEMIOLOGY  
OF  
HEAD INJURIES**

*To*

*Ravi and Shelma*

*With best wishes from*

*G. Srinivas*

**PROJECT REPORT**

**SUPPORTED BY :**  
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BANGALORE**

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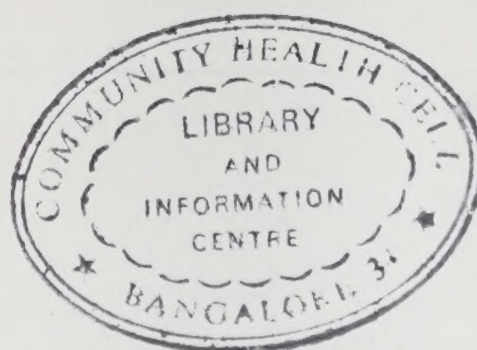
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*For CHIE-CPHE section  
Swarnan  
28/5/09*

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KARNATAKA STATE COUNCIL FOR SCIENCE AND TECHNOLOGY  
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PROJECT REPORT



KARNATAKA STATE COUNCIL FOR SCIENCE AND TECHNOLOGY  
BANGALORE

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## 2. INTRODUCTION

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The significant increase in morbidity and mortality from injuries and head injuries during the past few decades has been a matter of increased concern all over the globe. The epidemiological transition in both developed and developing countries like India due to integrated efforts in the prevention and control of communicable diseases has changed the health scenario in totality. The emergence of non communicable diseases has brought into sharp focus, behaviour linked and manmade disorders among which injuries and head injuries occupy a significant place. The unchecked rapid urbanisation and Industrialisation coupled with increased transportation all over the world has led to a dramatic increase in the occurrence of injuries and head injuries. An improved health information system has also contributed for realising the growing importance of injuries. The enormous impact on the society in terms of the economic cost and the devastating effects on the quality of life of injured persons and their families is phenomenal in every country(1).

A key element in the economic development of both developed and developing countries has been an increase in urbanisation, modernisation and Industrialisation which is always closely linked to the development of transportation facilities within the country. The progress associated with this process has contributed to an increase in gross national products and improvement in the total socio economic development in every country(2). A concomitant, accompaniment of this change has been the significant increase in the number of transport vehicles on the roads. A corresponding increase in the supportive elements of this change like increase in safety technology, improved road safety mechanisms, increased accessibility to medical services and a change in the attitude of road users has not been noticed.

There has been a growing interest in injuries and related issues during the past few years. It is widely acknowledged that injuries occur due to a complex and predictable interaction of events and mechanisms which are preventable. Injuries also cause considerable amount of suffering, misery, pain and grief for the individual and his family. The impact of injuries on the quality of human life and productivity are a direct reflection of its manifestation. Many countries have also realised that injuries drain away considerable resources at different levels(3). The economic impact, loss of productive man years and the burden on the family and individual due to disability is higher than any other illness(4).

Among the several types of injuries, head injuries occupy a significant place because of the sudden mortality and morbidity inflicted on the victims. The damage to the nervous system also leaves long standing deficits and disabilities for the human being. Since the nervous system is the predominant control organ in the body, damage to this vital part can lead onto sudden death and serious disabilities for the rest of individuals life.

Head injuries can occur at any place and at any time even-though some specific patterns are known. Head injuries have been known to occur on the road, at home, at work site, a construction place and in any other specified or unspecified place. Among the different causes of head injuries, undoubtedly, road traffic accidents (RTAS) contribute for a significant proportion. The other known causes are falls, fall or hit by an object, firearm injuries , industrial accidents and a few others. The corresponding severity is decided by the impact of the object or the force which inflicts injury along with host susceptibility factors. The severity is also influenced by a multitude of other factors like site of occurrence , accessibility and availability of first aid and medical care, the associated co-morbidity, the interval between occurrence and reaching hospital, nature of head injury, severity of head injury, associated injuries, utilisation of health services, paying capacity of the individual and many other medical and social factors.

Epidemiological contribution towards injury and head injury prevention and control has been acknowledged world over. The recent decades have witnessed the emergence of injury epidemiology and head injury epidemiology as distinct disciplines. In order to evolve suitable policies and programmes , epidemiological information play a vital role by enabling decision makers to get a clear understanding of the problem in its various facets . This can specifically help in understanding the magnitude of the problem, causes of head injuries, severity of injuries, consequences in terms of mortality, morbidity and residual disability, the need for acute care, rehabilitation, economic cost and prevention by specifically developing data on various issues at different levels(5).

The source of information for head injuries can be from the hospital or the communities and also data from various other sources like police records, school records, industrial records, insurance company information and others. The information from these collateral sources reflect more on cause of injuries. The quality and content of information will vary depending upon the source, purpose, personnel collecting and utilising data (6). Even

though pooling of information is desirable, it has been a difficult task due to various reasons. Population based epidemiological information is highly valued, but, the problems encountered in terms of case identification and ascertainment make this a difficult endeavour. This source accurately provides information even on cases which are of a mild nature not seeking help from major hospitals. However, due to considerable resources involved in generating such data, hospital statistics are preferred. Hospital studies can provide indepth information on all types of head injuries and other injuries and are less expensive. The obvious disadvantages are that proper medical records are nonavailable, less severe cases are missed out and cases may not represent the geographical representativeness of the problem being studied in a routine way(7,8). However if sufficient attention is paid to these aspects, hospital statistics can be a very useful source of information.

The figures from hospital and collateral sources represent only the tip of the iceberg. The possible reasons for this could be gross under reporting and deficient case registration along with the problems of varying case definitions of head injuries, difficulties in case diagnosis and lack of cooperation by anxious patients. Difficulties in standardising the methodology contribute enormously to this problem. Information on head injuries has been very limited and scarce. It is of vital importance that accurate information on head injuries be available in every country to evolve suitable policies and programmes. The present study is an attempt to study the magnitude of the problem and related aspects of head injuries in a rapidly developing city with a view to enable policy makers for developing programmes aimed at prevention, management and rehabilitation.

### 3 . INJURIES IN INDIA

With the changing health scenario, injuries have become a major public health problem in India. The non availability of reliable statistics have made the situation complex and confused. As per the information available in 1989, accidents and injuries accounted for 7.0% of total deaths. The highest number of deaths were observed in 15-24 yrs and 25-34 yrs with an age specific mortality rates of 22.7% and 19.9% respectively (9). Accurate data from several sources like transport injuries, domestic injuries, occupational injuries, playsite injuries and others are required to arrive at a clear picture on the magnitude of the problem. In a recent review by Dinesh Mohan, it has been estimated that about 3,40,000 persons lose life because of injuries every year in India and about 10 to 20 times (3,400,000 - 6,800,000) Persons are seriously injured or disabled. As per a WHO report about 13 % of the world population is disabled and 15 % of these are due to injuries. As per this estimate about 78 million people are disabled by injury with India contributing to 18 % of this total number. It is a common understanding that hospitals in India treat a large number of injured patients, which, is more than any other illness. Injuries are cleraly a major problem in developing countries like India as in any other developed country(10).

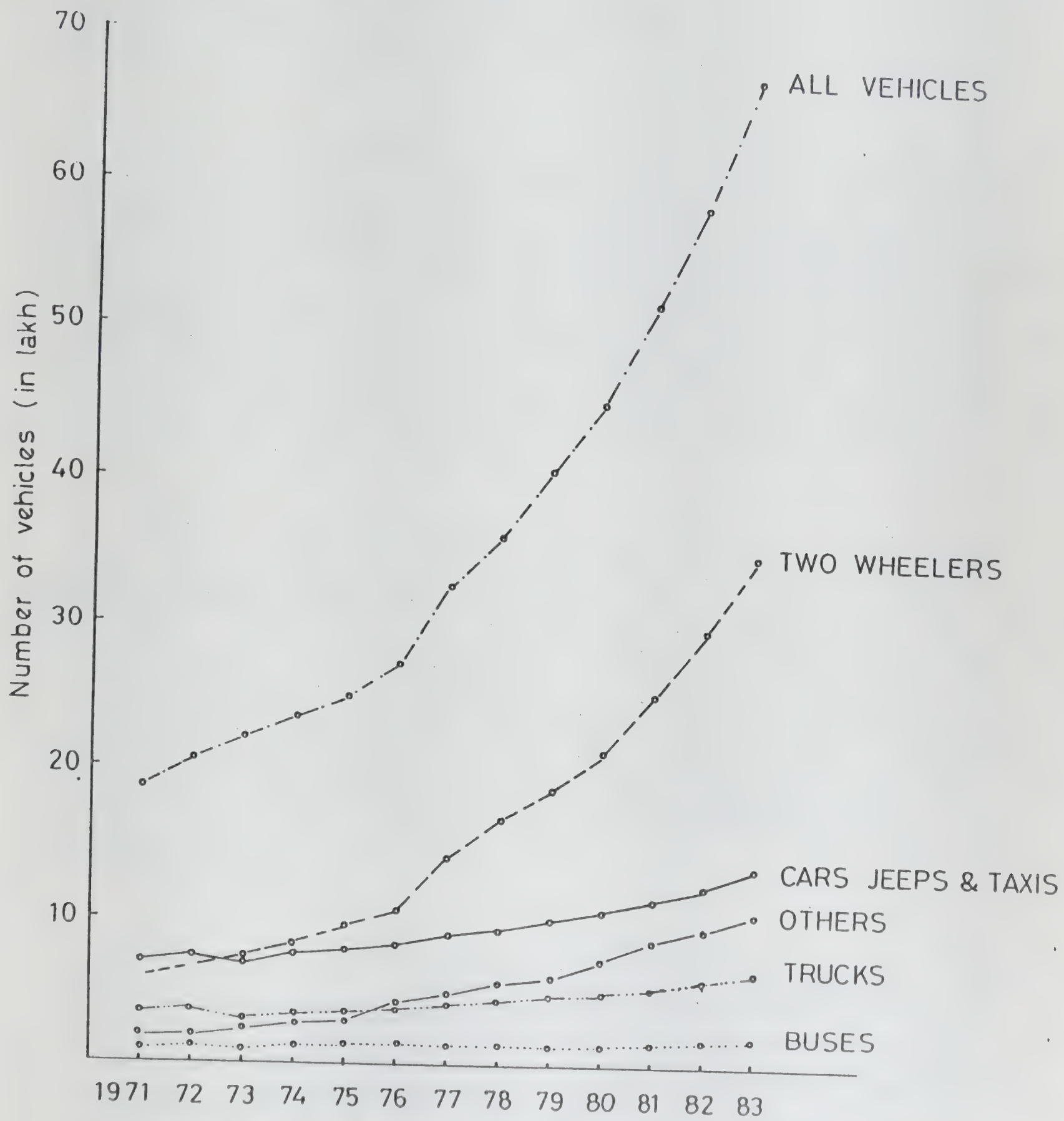
Among these injuries information is available in a comparatively better manner for transport injuries as compared to any other causes as they account for a major share of mortality, morbidity and disability. In a recent report by the National transportation planning and research centre it has been mentioned that (11),

1. During the last three decades, the growth of motor vehicles has increased by more than 20 times, With a phenomenal increase in two wheeler vehicles.
2. In the year 1981, number of accidents per 1000 vehicles was as high as 31.8 in India as compared to 8.7 in Japan, 13.3 in West Germany and 6.8 in Sweden.
3. The total number of accidents has increased from 55,478 in 1960 to 1,14,079 in 1970 and to 1,70,844 in 1983.
4. The number of persons killed has gone upto 30,471 in 1983 from 5,106 in 1960. The number of persons injured has increased from 37,731 in 1960 to 1,31,430 in 1983.

5. The fatality rate of 5.9 per 1000 vehicles was also high as compared to 0.39 in UK, 0.87 in France, 0.61 in West Germany, 2.7 in Sweden and 2.0 in Japan.
6. The four southern states account for 24.02% of total accidents, revealing that accident rates are highest in Southern states of India.
7. Seventy five percent of accidents occur in the country on urban roads which form only 6% of total road network in the country.
8. Ten major cities account for 50% of total traffic accidents in the country.
9. The fatality rates per 10,000 vehicles varies from 15.1 in Ahmedabad to 42.2 in Bombay with Bangalore registering 33.3 in 1970. This has declined to 7.2, 21.9 and 20.9 respectively by 1981. Caution has to be exercised in relating this data as number of vehicles and population have registered a phenomenal increases during this period.

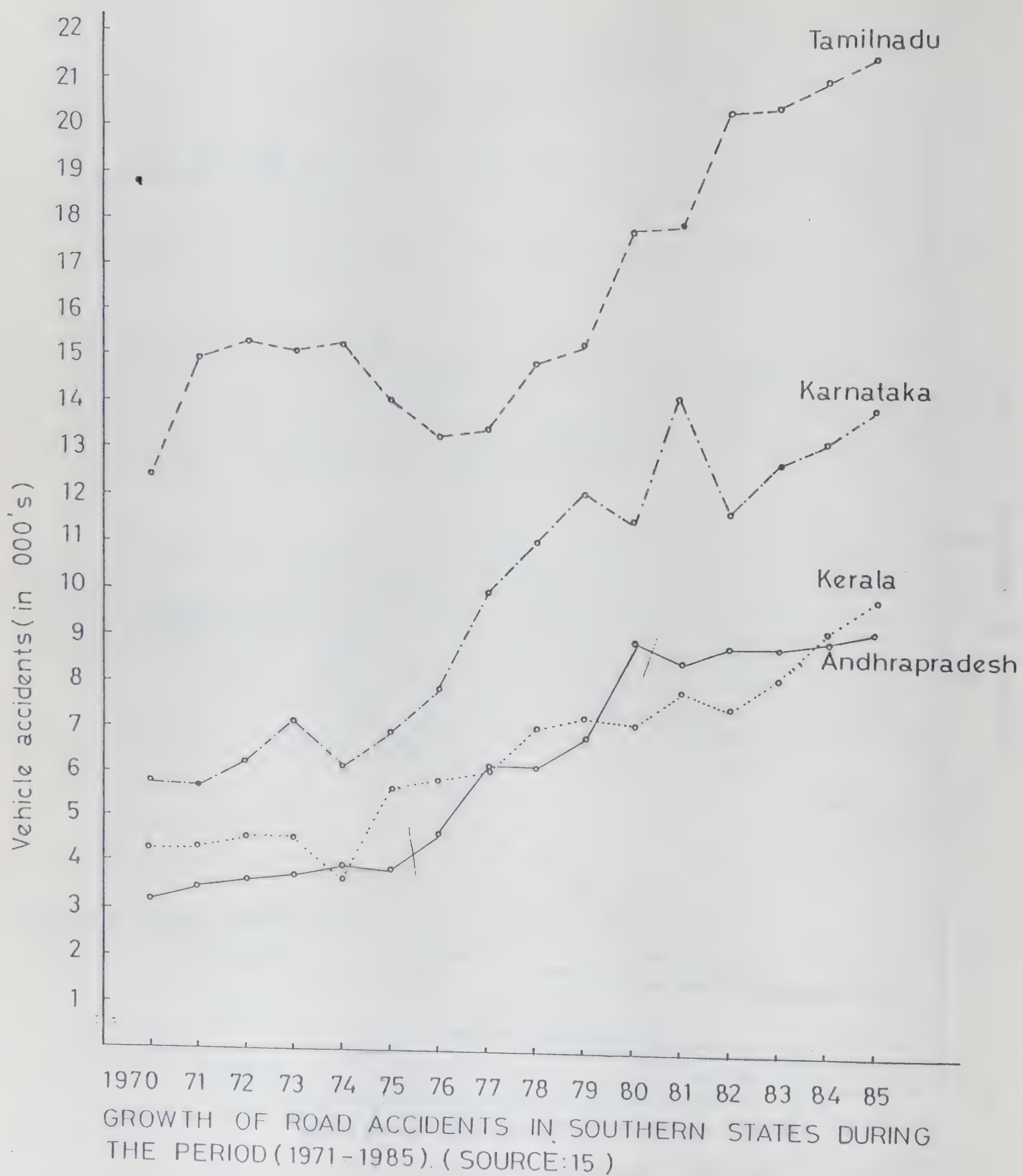
Figure 1.1 and 1.2 show the increasing number of vehicles and road traffic accidents in India during 1971 to 1985. This comprehensive report summarises the alarming situation about injury morbidity and mortality. Information on other types of accidents has been limited in this country. Domestic accidents are a frequent cause of death and disability at extremes of life (12). Industrial accidents are also a frequent type of Injuries and also impose a heavy burden on the economy. Burns and poisoning being important types of Injuries, reliable information is lacking for the whole country.

FIGURE. 1.1.



GROWTH OF MOTOR VEHICLES IN INDIA (1971-1983) (SOURCE: 15)

FIGURE 12.



#### 4 : HEAD INJURIES IN INDIA

Collectively, at the national level, information on magnitude of problem, type, causes, nature, outcome and sequelae of head injuries is not available in India due to various administrative, operational and other problems. Health information systems as noticed in the West are also not existent. In view of this, it becomes difficult to critically examine this problem from a national perspective.

However, studies have been done in different parts of the country by individual researchers(13 - 17). This is often determined by individual areas of interest, place of working, availability of resources and other aspects. The emphasis has been predominantly on clinical subjects involving small groups of head injured patients, usually selected because of medical settings or circumstances because of individual's interest. In view of the different definitions, case finding methods, instruments, focus of interest and non-uniform group of patients it is difficult to compare for evolving commonalities. Despite these limitations, a few studies are available to understand the basic problem as noticed in different centres.

The information available from Indian studies undertaken in different parts of the country clearly establish the increasing problem of head injuries. However, none of the studies have established clearly the incidence or prevalence of the problem. Majority of the studies conclude that road traffic accidents/Traffic related injuries as the principle cause varying from 40-60 % of the cases. Assaults, falls, fall or hit by an object and industrial accidents have been identified as other causes. Head injuries due to falls have been noticed more commonly in paediatric and geriatric age groups. Majority of these studies have also recorded a male preponderance with highest number of cases in the age group of 10 - 40 years. Alcohol has been found to be a major risk factor for head injuries(15).

The overall mortality has been found to vary in different studies from 50 % to 15 %. Studies on sequelae from head injuries has been very limited. In a series of 2190 cases, 21 % were found to have neurological deficits. About 13 % were found to be suffering from neurosis after a period of 3 - 6 months(16). In a study at Madras it was observed that 55 % recover totally in 3 months, 38 % continue in an abnormal state and 7 % had totally deteriorated(18).

With the magnitude of the problem being so enormous, efforts towards prevention have received very low priority in developing countries like India. Several interventions in the west have demonstrated that mortality and morbidity from head injuries can be reduced (19,20,21), but unfortunately, efforts are long overdue in this area in many countries. While prevention has been accorded low priority, timely rehabilitation has been a neglected area.

A major lacunae for work in this direction has been the lack of adequate research information across different parts of the country. Even though multiple sectors are involved in Injury related activities, compartmentalisation of information and lack of integrated efforts through a multidisciplinary approach has been the major hindrance for developing relevant, appropriate and meaningful programmes. It is clear that strategies towards prevention, management and rehabilitation must be accorded top priority.

## 5 : SITUATION IN BANGALORE

The city of Bangalore is one of the rapidly progressing cities in India and also in South East Asian region. The city is the capital of Karnataka and has a population of 4,086,458. The district has been divided into Bangalore urban and rural for administrative purposes. Bangalore urban had a decennial growth rate of 20.69 during 1981-91. The city has a population density of 2204 per sq km ( average for Karnateaka State - 234 Per Sq Km). Male to female sex ratio as per the latest census is 960 females per 1000 males. The literacy levels of population is 66.2% ( Males 72.1% and females 59.7%) (22).

Since the pace of urbanisation accelerated enormously from 1960's, the city of Bangalore has recorded unprecedented growth in all aspects. It is known clearly that cities in developing countries are growing at a much faster pace than cities in developed countries. The pace of population growth has been unidirectional without corresponding increase in related areas thus leading onto 'crumbling effects' on quality of life. A key aspect of this rapid urbanisation to progress towards modernisation has been the increased motorisation with an accompanying rise in traffic related injuries and deaths due mainly to head injuries. Table 1 and Figure 2 shows the increase in motor vehicles in the city of Bangalore during 1985-1991.

Table 1 : Registered vehicles in the city of Bangalore

As on	31.01.92		31.07.92	
	No.	%	No.	%
Two wheeler vehicles	4,92,906	75.6	5,16,703	75.8
Motor cars	89,844	13.7	92,976	13.7
Jeeps.	6,734	1.0	6,938	1.0
Autorickshaws	22,760	3.4	23,723	3.5
Motor cabs.	2,678	0.4	2,990	0.4
Omni Buses	2,784	0.5	2,877	0.4
Station wagons	179	0.1	179	0.1
Buses	4,726	0.8	4,913	0.8
Goods vehicles	21,358	3.2	21,488	3.2
Tractors	2,187	0.4	2,252	0.3
Trailors	1,885	0.3	1,951	0.3
Fire engines	104	0.1	110	0.1
Delivery vans.	2,376	0.4	2,685	0.4
Ambulance vans	155	0.1	161	0.1
Others.	947	0.2	973	0.2
Total	6,51,623	100.0	6,80,919	100.0

As per the latest figures available for the city, about 7 lakh city registered vehicles and a similar number of vehicles from outside the city use the available roads thus amounting to increased density of vehicles on the roads. The exact number of vehicles as on 31.07.92 stands at 6,80,919 with two wheelers numbering 5,16,703 (75.8%). Approximately about 25,000 new vehicles are added onto the city roads every month. It can be noticed that about 160 new vehicles are registered every day, out of which, about 130 are two wheelers. The distribution of other vehicles is shown in table 1 (23).

The city has also seen rapid increase in the number of large and small industries. The increasing population in the city coupled with unchecked migration has also added to the problem. An increase in the number educational institutions, transport vehicles, housing construction activities within the city has given rise to major urban problems. The rise in number of vehicles owned by college going youth has been a significant phenomenon. Construction site head injuries and head injuries due to fall from height or fall of an object are a common mode of head injuries, a picture definitely varying from the west.

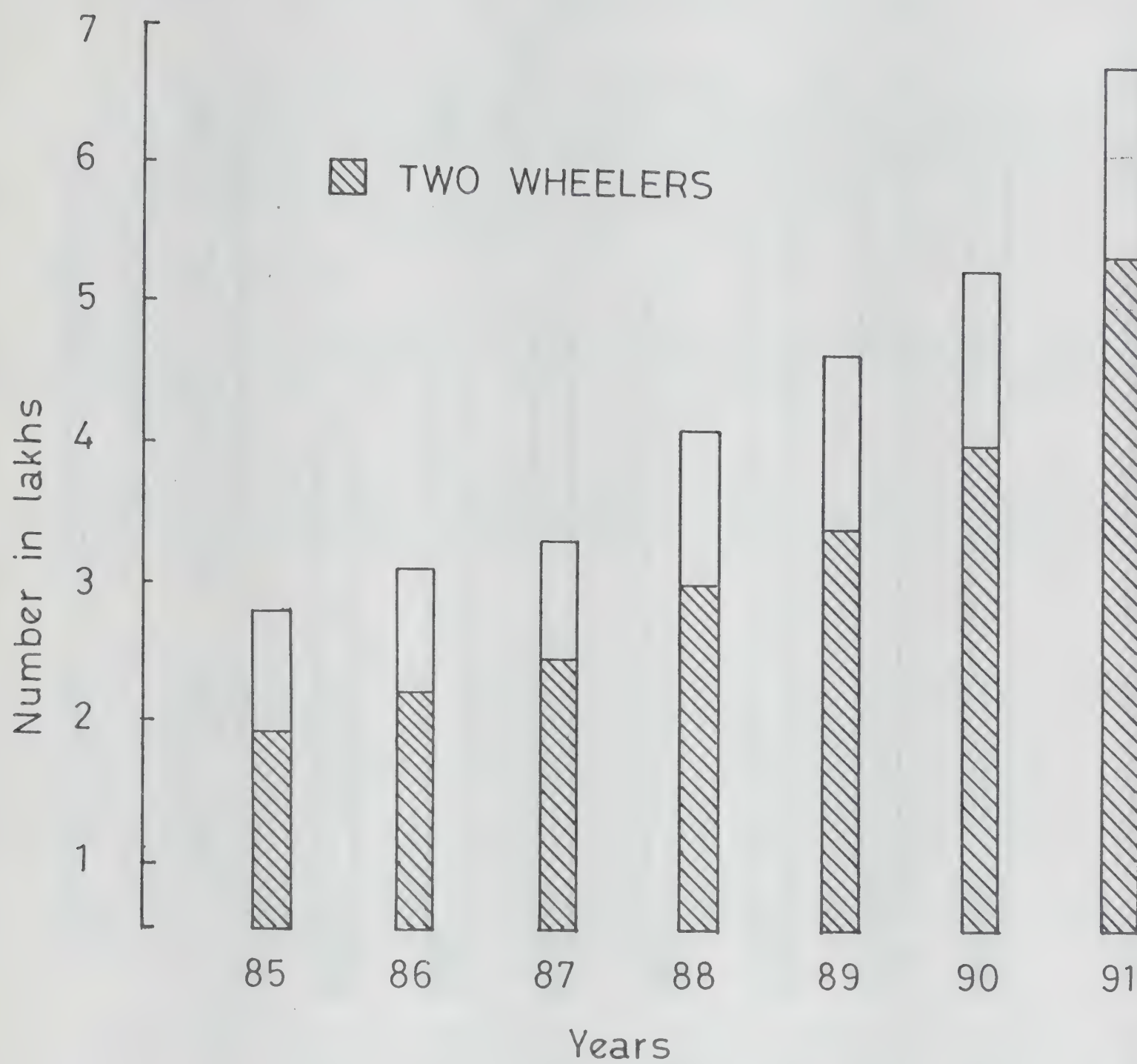
Organisation and provision of services for head injury victims and rehabilitation has to take the emerging development in other sectors. The health care infrastructure for Injury and head injury victims is poor as compared to any other country. A Health Information system for head injuries is virtually nonexistent in the city of Bangalore. Several problems like lack of total case registration, lack of case ascertainment, cross referral within hospitals, incomplete death records registration, differing interval between site of injury occurrence and reaching a hospital compound the existing problems.

The city police department is the only source maintaining a complete record of injuries and deaths for the city (figure 3). However, it has to be taken note that every injury case is not registered with the police due to situational problems. The data available from police records reveal that (24) :

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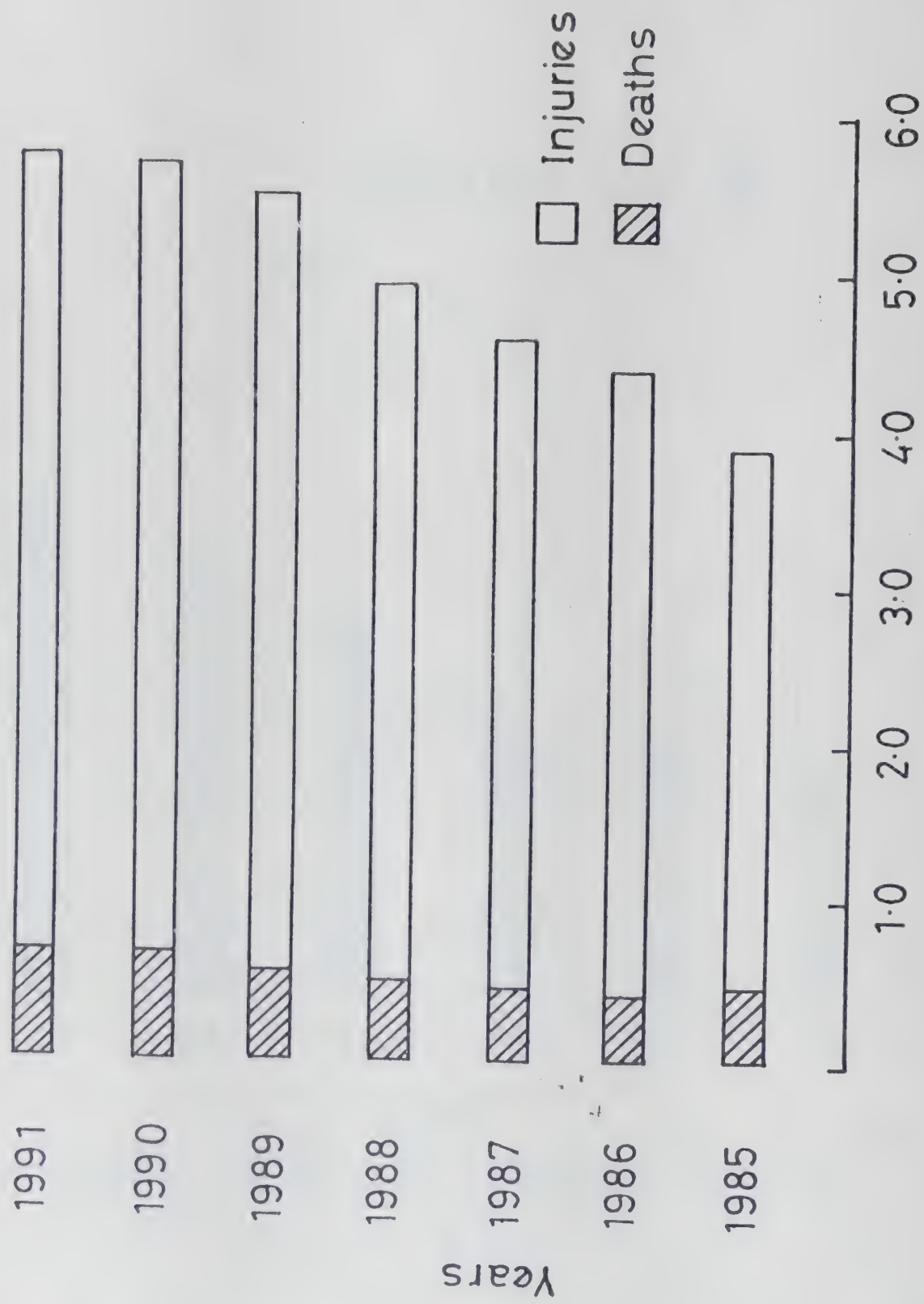
1. The number of injuries has been steadily increasing from 3,800 in 1985 to 5600 in 1991 (around 6000 in 1992). cases. This leads onto the conclusion that about 600 cases of injury are registered every month due to road accident in Bangalore. Highest number of injuries had occurred in the age groups of 19-30 yrs to the extent of 40 % during the year 1990.

## 2. REGISTERED VEHICLES IN BANGALORE (1985-1991)



Source : Transport department, Bangalore.

### 3. ROAD TRAFFIC ACCIDENTS IN BANGALORE (1985-1991)



( In thousands )  
( Source: Police Department, Bangalore. )

2. The number of people killed in road traffic accidents has also increased from 420 in 1985 to 550 in 1991 with an average of 45 deaths per month.

3. A comparative look at the age specific mortality rate reveal that mortality in the age group of 19-30 years has increased from 28.7 % in 1988 to 34.5 % in 1990.

4. During the period of 1988-1989 ,the category of road users killed was predominantly constituted by pedestrians, motor vehicle riders and pedal cyclists to the extent of 40 %, 22.4 % and 14.3 % respectively with minor variations during the years.

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Apart from this brief observation which represents only the tip of iceberg, no scientific studies are available except a small study by Mohan etal (25).

Studies on the problem of head injuries in particular have been very little in the city of Bangalore. It is clearly known that head injuries constitute 20-40 % of total injury cases varying from place to place.

A preliminary study conducted on cases registered in Emergency service department of NIMHANS during Jan-Feb 1988 was of a retrospective nature on a sample of 478 cases through a record analysis(26) .The study disclosed that about 30 % of cases in ERS of NIMHANS was constituted by head Injuries. Highest number of cases were recorded in the age group of 15-35 yrs (50 %) with a male to female ratio of 5:1. Road traffic accidents ,falls,and hit by fall of an object contributed for 59.6 %,28.3 % and 7.5 % of cases respectively. About 16 % of cases were admitted at NIMHANS for detailed investigations and management.

This study was followed by a study on factors contributing to mortality from head injuries(27) undertaken during 1989-1990 with the objectives of delineating trends and to identify the role of individual factors on 262 deaths recorded in one year revealed that:

- \* Mortality was highest in the age groups of 35-44 yrs and 25-34 yrs to the extent of 21.8 % and 18.4 % respectively. Children and Elderly accounted for 10 % each accordingly.
- \* During the period 1985-1990 mortality in the age group of 15 -54 yrs increased from 60 % to 75 %.
- \* Only 5.7 % of victims had reached the hospital within 1 hour after the injury occurrence.
- \* RTAS, Falls, Assaults and Fallof an object had contributed for 61.5 %, 22.5%, 3.8 % and 4.6 % respectively.
- \* Pedestrians , Motor cyclists and occupants of motor vehicles were killed in 24.7 %, 16.7 % and 14.2 % respectively with Pedal cyclists accounting for 9.3 % of cases.
- \* Grade 4 and Grade 5 levels of consciousness was recorded in 45 % and 28 % of cases at the time of reaching our hospital.
- \* About 15 % of patients died soon after arrival , within one hour.
- \* Prior Alcohol consumption was observed in 10 % of cases.

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## 6.NEED FOR AN EPIDEMIOLOGICAL STUDY

The above mentioned studies in the city of Bangalore suffer from methodological limitations as mentioned earlier. The need for a large scale ,prospective study on the problem of Head injuries was felt by the research team to:

1. Enable policy makers to evolve programmes for prevention,acute care and rehabilitation based on a scientific rationale.
2. Study the problem on a broader basis involving several hospitals and also by generating and pooling data from multiple sources.
3. Increase awareness and participation among professionals,public and media by generating information on various aspects of head injuries
4. Examine the problem of head injuries in a wider perspective for the whole city to understand the various aspects.

## 7. AIMS AND OBJECTIVES

The aim of the present study was to study the epidemiological dimensions of head injuries in a broader extent as applicable to the city of Bangalore through a sentinel hospital approach for generating information towards evolving suitable strategies for care, prevention and rehabilitation.

The specific objectives were :

1. To establish the magnitude of the problem of injuries and head injuries.
2. To know the influence of alcohol, drugs and comorbid conditions in head injury occurrence.
3. To study the causes of head injuries.
4. To understand the nature, type and mode of head injury occurrence.
5. To outline the pathways of care and outcome among head injury patients.
6. To delineate the problem and types of sequelae among head injury victims.

## 8. DESIGN OF THE STUDY

### Phase I - Preparatory Phase

- |     |   |        |
|-----|---|--------|
| (a) | Identification, contact, establishing liason, meeting of all hospitals. |        |
| (b) | Development of study Instruments.                                       |        |
| (c) | Selection & Training of field investigators.                            | M      |
| (d) | Pilot study.  | O      |
| (e) | Information pooling   | N      |
| (f) | Formulation of head injury advisory group and preliminary discussions.  | I<br>T |

### Phase II - Data collection phase

- |     |  |        |
|-----|--|--------|
| (a) | Information collected from head injury patients. | R<br>I |
| (b) | Information collected from injury patients.      | N      |

### Phase III - Follow up activities

- |     |  |                  |
|-----|--|------------------|
| (a) | Information from head injury patients by domicillary visits. | G<br>&<br>F<br>E |
|-----|--|------------------|

### Phase IV - Data pooling activities

- |     |   |                       |
|-----|---|-----------------------|
| (a) | Information from allied sectors of police, transport, industries, health and corporation officials. | E<br>d<br>B<br>A<br>C |
|-----|---|-----------------------|

### Phase V - Data analysis and report development

K

## 9. MATERIALS AND METHODS

### OUTLINE

- Study Place : Bangalore.
- Study Centers : 7 Hospitals in the city.
- Study duration : Phase 1 : Upto Sept. 1991.
- Phase 2 : Sept.1991 - Feb.1992.
- Phase 3 : March 1992 - May 1992.
- Phase 4 : June1992 - Dec.1992.  
& 5
- Study Instruments:
- 1.Specially designed, pretested coded proforma for first contact information.
  - 2.Specially designed, pre tested coded proforma for followup information.
- Study Subjects : All patients registering for the first time as per the definition of head injury .
- Study Team : Project investigators and eight trained field investigators.

An instruction manual clearly specifying the operational guidelines was developed for the purpose of the study. This was fully adopted for the training of investigators throughout the study period.

9.1. Selection of hospitals : Since this was a hospital based study, We adopted the concepts of a Sentinal approach for identifying the study centres in Bangalore. The criterias under which hospitals were identified were :

- a) Greater attendance of patients with head injuries reporting to these hospitals as a source of agency for help.
- b) Willingness of the staff to participate in the project.
- c) Availability of reasonably good medical records.
- d) Easy accessibility for rural-urban population.
- e) Geographical limits to cover the entire city.

The nature of hospitals included varied in terms of their characteristics. H1 is a tertiary referral institute for management of head injuries, H2 is a referral hospital for management of injuries, H 3,4 and 5 are hospitals with provision for treatment of head injuries and injuries, H 6,7,8 are centres with provision for emergency and injury treatment without specialised neurosurgical facilities.

The situation of these hospitals is given in figure 4 and a profile of these hospitals is furnished in table 2.

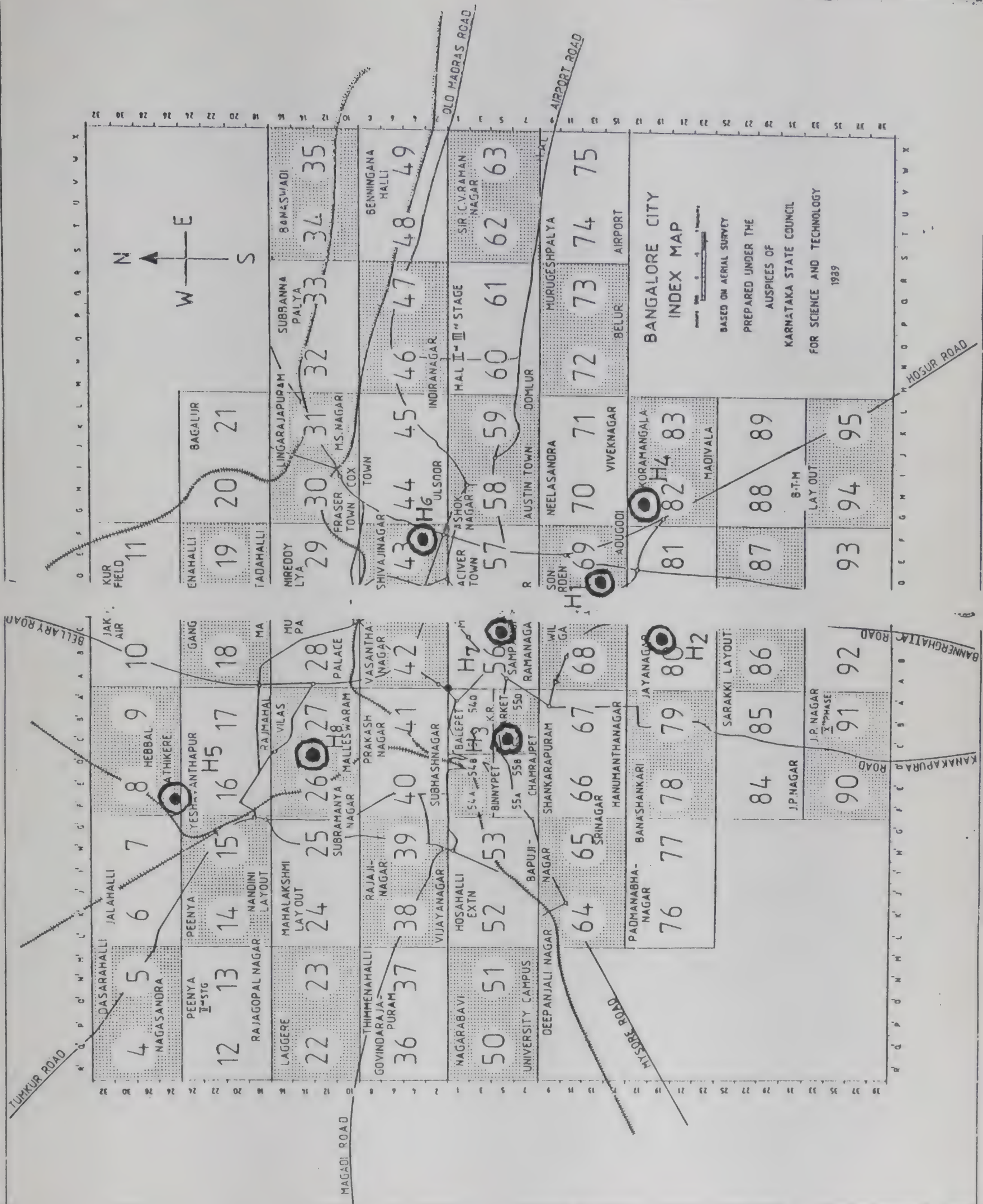
## 9.2 Preparatory Phase

Soon after the hospitals were identified, discussions were held with the hospital administrators, concerned consultants in casualty, Neurosurgery and Orthopaedic departments requesting them to participate in the study. Permission was obtained from hospital authorities for including their patients in the study. Contacts were also established with medical records officers for obtaining records . Out of the 10 hospitals identified in this manner, adequate response was forthcoming from 8 hospitals and were included in the study. Data collection from one hospital was terminated due to operational problems . Thus data collection for the total study period was done from seven major hospitals. Periodical discussions were held throughout the study period for providing a feedback on the study and its implications regularly. The state directorate of health services was also kept informed throughout this period.

Table 2 :Profile of study centres

Sl.	Name of the hospital	Nature of hospital	catchment area	Medical records	Ambulance services	emergency services	post trauma services	neurosurgical care	additional features
1	NIMHANS	Government	wide area	good	yes(2)	present	present	present	Teaching
2.	Sanjaya Gandhi Accident Relief Complex	Government	Wide area	Adequate	Yes(5)	Present	Available	Present	Non-teaching
3.	Victoria hospital	Government	Wide area	Adequate	Yes(2)	Present	Available	Present	Teaching
4.	St. John's hospital	Private	Wide area	Good	Yes(2)	Present	Available	Present	Teaching.
5.	M.S.Ramaiah hospital	Private	Wide area	Good	Yes(1)	Present	Available	Present	Teaching
6.	Bowring hospital	Government	Wide area	Adequate	Yes(1)	Present	Available	Absent	Teaching
7.	K.C.General hospital	Government	Wide area	Adequate	Yes(1)	Present	Available	Absent	Non-teaching.
8.	St. Martha's hospital	Private	Wide area	Good	Yes(1)	Present	Available	Absent	Teaching.

FIGURE 4. LOCATION OF STUDY CENTRES





### 9.3 Selection and Training of Investigators

Eight investigators with a background in Sociology or social work or rural development with a previous experience of health reserch in hospital and community were selected. Familiarity in local languages was an important criteria. These investigators were trained in various aspects of research during the period of one month (August 1991). Their training consisted of

- a. Theoritical orientation towards problem of Injuries and head injuries.
- b. Familiarising and understanding different items in proforma through individual and group discussions.
- c. Translating and back translating to English.
- d. Mock Interviews.
- e. Interview of patients in Screening Block, Emergency services and Neurosurgical wards of NIMHANS.
- f. Guided, Supervised Interviews in Emergency. service departments of NIMHANS.
- g. Data entry and coding practices.
- h. Pilot study in identified hospoitals.

In this way, the field investigators were clearly trained in all aspects of data collection, data entry and coding practices. A training manual was prepared before the initiation of project. ("Instruction manual for field investigators on the project Epidemiology of Head Injures" - copy available on request) which was fully utilised during the study period.

After their training, they were introduced to their identified hospitals by project investigator and familiarised with local procedures. A pilot study was done before the actual study was undertaken.

#### 9.4 Study Instruments

The instruments used in this study were

- i) Proforma for first contact information ( App. III)
- ii) Proforma for followup information ( App. IV)

The proforma for first contact information consisted of 62 items covering seven major areas. These were (i) identification variables, (ii) socio demographic characteristics, (iii) Information on risk factors and co-morbid conditions, (iv) Injury details, (focussing in detail on road traffic accidents, fall, assault, fall of an object and Industrial accidents (v) referral information (vi) clinical aspects and (vii) management information.

The identification variables consisted of details on registration numbers, hospital admitted, date and time along with source of information.

The socio-demographic information consisted of name and age of patient along with address. Both residential and occupational address of the patient along with telephone numbers in available situations were recorded. Additional information consisted of religion, education, occupation, family income, family size along with marital status. The occupational categories were coded as per the ICMR classification procedures.

The personal information with regard to the various risk factors focussed mainly on smoking, alcohol and consumption of drugs. Since alcohol is found to be the major risk factor in the occurrence of head injuries, information collected from the patient was cross examined with medical and police records at the time of registration. Consumption of alcohol was established by self reporting/breath examination/medical documentation/police records. Blood alcohol levels were not estimated as it is not done routinely in hospitals. Presence of co-morbid conditions was elicited mainly from patients and their relatives and cross verified with referral letters and medical records.

Details on information about the occurrence of head injuries consisted of mode of arrival, date, time, day and place of occurrence. The injury site was mainly classified as road, industrial, construction, domestic, play site, agricultural and others. Details about the address of injury location was also entered into the proforma. The time interval between occurrence of injury and medical contacts was recorded in number of hours to

ascertain the time interval before treatment was provided to the victim. The cause of head injury was mainly classified as per the standard practices and corresponding details were elicited.

Further details about various aspects of each of these causes to precisely understand the nature, mode and type of head injury was elicited. The injury classification procedures as per the ICD-9(external causes) methodology was adopted in this study. More details about the type of vehicle involved, status of the injured person and usage of protective equipments were recorded. Details about the nature of fall, reasons, height of fall and area of head injured were recorded. The type of assault, nature of an object falling on the head along with mode and area of fall were documented. Both in fall and fall of an object, the height of fall was specifically elicited to assess the impact of fall from greater heights. Details about industrial accidents were also included in specific situations.

To assess the importance of immediate first aid services for head injury victims ,information was noted on availability, source and the referral agency for the victim. The cost incurred till the patient reached a definite hospital was also recorded.

The clinical information consisted of predominantly various aspects on the level of consciousness, post traumatic amnesia, presence of seizures, nature of external injuries, presence of skull fracture and various associated injuries. The severity of injury was measured as per the glasgow coma scale at the time of hospital registration . The clinical information was mainly obtained from attending consultants and medical records. Since the purpose of the study was explained to all concerned people, greater attention was focussed on recording information by treating doctors in all hospitals. The referral letters brought by patients was also reviewed by the investigators in necessary situations. The nature of injuries along with final diagnosis was recorded in consultation with the attending physician and coded as per the ICD-9 practices. The procedure followed at NIMHANS for classification of head injuries was also adopted as it was found to be more elaborate and useful.

The management information was collected at the end of their recommended hospital stay along with the duration of hospital stay. The final status of the patient was obtained at the time of discharge of the patient from the individual hospitals in consultation with the patient and attending medical consultant.

The proforma for follow up information primarily consisted of (i) present health status of the head injured person (ii) Opinion on care provided during initial contact (iii) Nature of current follow up care (iv) sequelae of head injury and (v) Prevention of head injuries based on his experience.

The follow up information was collected from 425 patients, who were residents of Bangalore and having sustained head injury during the period of study. The information collected mainly focussed on the present health status, mobility status, working or schooling status and whether patient had returned to his previous occupation. The current source of income along with absenteeism was enquired. The opinion of the patients on the care, referral and education provided during their initial hospital contact was enquired to ascertain their satisfaction over the nature of care provided to them. The expenditure incurred in relation to their head injury even after discharge from the hospital was specifically noted. The various sequelae from head injury was enquired to elicit problems present after the occurrence of the injury. Finally, the suggestions given by the patients based on their initial experience was recorded.

#### 9.5 Data Collection Procedures :

Data collection was done mainly in the casualty divisions and attached wards of individual hospitals from all patients with a definite history of head injury through direct interviews by trained investigators. For the purposes of this study, a case of head injury was defined as

"a person with a history of definite injury to the head by an external agent accompanied with (a) short or long spell of definite loss of consciousness (b) an obvious recognisable neurological deficit and or (c) accompanying skull fracture. "

Investigations into problems of head injuries requires considerable amount of judgement and human touch by the investigating team because of considerable pain, grief, suffering and anxiety by patients and accompanying persons. Hence, the following points were paid special consideration during data collection.

- a) The injured person was interviewed only after examination and treatment by the attending medical person.
- b) In situations of fully unconscious patients, information was collected from the person accompanying the patient.

- c) Information was kept totally confidential.
- d) Information was collected only after obtaining oral consent from the patients and accompanying persons.
- e) The Investigator was not allowed to treat or to give any false hopes and promises to patient as the responsibility of management rested with attending medical faculty.

#### 9.6 Information Pooling:

One of the objectives of the study was to examine the problem of head injuries in a wider perspective of injuries. It is essential to have information from other related areas to achieve this objective. Brief information from injuries was collected from all registered cases during the study period. This consisted of salient information on brief identification characteristics, cause of injury, nature of injury, date and time of injury, first aid care. This information was entered into separate injury registers maintained for the specific purpose.

Information was also pooled from the departments of police, transport, industries, associations of nursing homes and general practitioners, corporation health office (to examine death certificates) and from public specially on their opinion regarding helmet wearing during study time.

#### 9.7 Follow Up Phase:

It is well known that sequelae from head injuries has not been studied in detail. The present study focussed in detail on answering this question.

Among the total head injury cases, 425 (25%) were selected based on the following criteria.

- (i) Patient should have registered in one of the identified hospitals with a specific diagnosis of head injury.
- (ii) Patient should be a resident within the city limits of Bangalore.
- (iii) Patient must have been alive at the time of discharge or referral during first contact.
- (iv) Must have had a definite diagnosis of head injury

After making a list of patients eligible for follow up study, letters were sent requesting them to come to NIMHANS for follow up on any working day over a period of one month. Since the response to first postal letters was only 15% , it was decided to make home visits. All the remaining patients were contacted at home and information was obtained from them. It was essential to make second and third visits in 35% of cases as they were not available during first contact. Since follow up was done by trained field non-medical interviewers, a clinical examination could not be undertaken due to operational difficulties and resource constraints.

#### 9.8 Data analysis:

Data thus obtained was checked regularly for clarity, accuracy, completion and coding. This was entered into computer at regular intervals. The analysis was done using EPI-INFO (Ver. 5) software package(28).

#### 9.9 Monitoring and Supervision:

Throughout the study period, much attention was paid to this aspect. The monitoring was done at four levels.

- (i) Data collection in all the hospitals was regularly supervised and checked by the project officer .
- (ii) Data collection in individual hospitals was supervised by a local coordinator, identified for this purpose. Discussions were held on a regular basis with the local coordinator to solve day to day problems.
- (iii) The research team met regularly once in a month to review the activities.
- (iv) Feedback was given to all hospital authorities once in 2 months for understanding the problem.

#### 9.10 Review of activities

The entire project was reviewed at periodical intervals by an advisory group consisting of senior decision makers from Health, Police, Industry, road transport and media. Meetings were held regularly for sharing information, obtaining feedback and making midcourse corrections.

\* \* \* \* \*

By the above mentioned methodology, information was collected from 14036 injury cases and 2897 head injury cases from 7 sentinel hospitals in the city of Bangalore during September 1991 to February 1992. About 425 patients were followed at mean interval of 4.6 months to identify sequelae from head injuries during March 1992 to June 1992. Pooling of data from related sectors of police, industries, transport and corporation health offices was also done for the study period.

\* \* \* \* \*

## 10 & 11 : RESULTS

### OUTLINE

10. Problem of Injuries

11. Problem of head injuries

11.1 Incidence

11.2 Age-sex distribution

11.3 Socio economic characteristics

11.4 Alcohol , drugs and head Injuries

11.5 Co-morbid conditions

11.6 Cause of head Injuries.

11.7 Mode of arrival

11.8 Day and Time of occurrence

11.9 Place of occurrence

11.10 Interval between Injury and medical contact

11.11 First aid and referral services

11.12 Expenditure till hospital contact

11.13 Road traffic accidents

11.13.1 Location of head injuries

11.13.2 Mode of accidents

11.13.3 Vehicle and Status of person

11.13.4 Factors responsible for accident

11.13.5 Alcohol and road accidents

11.13.6 Helmets and head injuries

11.14 Falls and head injuries

- 11.15 Assault and head injuries
- 11.16 Fall of Objects and head injuries
- 11.17 Industrial accidents & head Injuries
- 11.18 Status at injury site and hospital entry
- 11.19 Clinical aspects
  - 11.19.1 External injuries
  - 11.19.2 Head injured area
  - 11.19.3 Seizures
  - 11.19.4 Associated injuries
  - 11.19.5 Skull fracture
  - 11.19.6 Severity of head injury
  - 11.19.7 Nature of head injuries
- 11.20 Management and outcome
- 11.21 Followup issues
  - 11.21.1 Current health status
  - 11.21.2 Head injury sequelae
  - 11.21.3 Cost of head injuries
  - 11.21.4 Suggestions by Injured persons & families

## 10 : INJURIES

During the period September 1991 - February 1992 ( 6 months) a total of 14,036 injury cases were registered in seven hospitals in the city of Bangalore. Out of these cases, more than 80% of cases were registered in the 4 hospitals as shown in table 3.

Table 3 : Distribution of injuries in study centres

Sl. no.	Name of the Hospital	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Total
2.	Victoria hospital	875	899	773	918	756	783	5004
3.	SGARC	217	282	230	214	281	267	1491
4.	K.C.General hospital	464	399	424	512	356	393	2548
5.	M.S.Ramaiah hospital	69	82	74	82	79	71	457
6.	St.Johns hospital	268	269	238	247	214	226	1462
7.	St.Marthas hospital	138	199	167	185	146	177	1012
Total		2332 (16.6)	2511 (17.9)	2222 (15.8)	2504 (17.8)	2198 (15.7)	2269 (16.2)	14036 (100.0)

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Among these cases ,11358 injuries had occurred within the city of Bangalore and 3678 had occurred outside the city amounting to 80.9% and 19.1% respectively. Approximately about 75 injuries occur every day or about 2300 per month in the city of Bangalore or 28,000 per year.

Table 4 Age - sex distribution

Age in years	male (%)	Female (%)	Total (%)
0-4	202 (1.8)	115 (4.6)	317 (2.3)
5-14	931 (8.1)	366 (14.5)	1297 (9.2)
15-24	2898 (25.2)	434 (17.2)	3332 (23.7)
25-34	3654 (31.7)	638 (25.3)	4292 (30.6)
35-44	2044 (17.7)	416 (16.5)	2460 (17.5)
45-54	1001 (8.7)	276 (10.9)	1277 (9.1)
55-64	455 (4.0)	142 (5.6)	597 (4.3)
65 +	314 (2.7)	121 (4.8)	435 (3.1)
NA	16 (0.1)	13 (0.6)	29 (0.2)
Total	11515 (100.0)	2521 (100.0)	14036 (100.0)

Male to Female ratio = 1 : 0.2

The Age - sex distribution of injury cases is shown in table-4. It can be seen that the age groups of 15-44 years constituted a total of 71.8% of total cases with highest number of cases occurring in 25-34 years (30.6%). Children and elderly constituted 11.5% and 3.1% of cases respectively. The ratio between men and women in our series was 1 : 0.2.

Table 5: Cause of Injury

Cause	No.	%
Road Traffic Accidents	7242	51.6
Assault	3793	27.0
Domestic Falls	1516	10.8
Industrial Accidents	453	3.2
Burns	717	5.1
Fall of an Object	156	1.1
Firearms Injury	20	0.1
Not Known	139	1.0
Total	14036	100.0

Investigation into cause of Injuries revealed that 7242(51.6%) of injuries were due to road traffic accidents. This was followed by assaults and falls in 3793(27.0%) and 1516 (10.8%) respectively as shown in table 5.A total of 717 (5.1 %) caes were constituted by burns. Thus it can be seen that majority of Injuries were due to Road traffic accidents.

Injury occurrence as per day and time of occurrence is furnished in tables 6 and 7 . It can be seen that majority of injuries occurred on Mondays at the beginning of week to the extent of 17.2% and least on Sundays to the extent of 12.4%. Also, more number of injuries occurred between 12 noon and 6 PM (32.9%), followed by 6 PM - 12 MN (29.0%), thus signifying evenings and nights were the peak periods of injury occurrence. The exact time of injury occurrence was not available in 8.5% of cases.

Table 6 : Injuries as per day of occurrence

Days	No.	%
Mondays	2416	17.2
Tuesdays	2022	14.4
Wednesdays	1954	13.9
Thursdays	1974	14.1
Fridays	1960	13.9
Saturdays	1973	14.1
Sunday	1737	12.4
Total	14036	100.0

Table 7 : Injury occurrence as per time

Time	No.	%
0 - 6 hours	781	5.6
6 - 12 hours	3370	24.0
12 - 18 hours	4617	32.9
18 - 24 hours	4074	29.0
Not known	1194	8.5
Total	12842	100.0

The mode of arrival was predominantly through public transport like buses, autorickshaws and taxis in 58.3% of cases.

Table 6 shows that only 16.8% had utilised ambulance services. Personal transport was available in about 9.8% of cases.

Table 8 : Mode of arrival

Mode of Arrival	No.	%
Ambulance services	2363	16.8
Personal Transport	1383	9.8
Public Transport	8185	58.3
Other Modes	432	3.2
Not Known.	1673	11.9
Total	14036	100.0

\*\*\*\*\* The broad classification on the nature of injuries revealed that 4958 (35.3%) cases were superficial injuries and contusions. Head Injuries constituted 21% of total cases. Orthopaedic Injuries accounted for 8.0% of cases. Burns comprised of 5.2% of cases specified were recorded in 23.2 % of cases. About 1.3% of cases had died immediately on arrival at the hospital.

## 11. HEAD INJURIES

### 11.1 Incidence of Head Injuries

During the period Sept. 91 - Feb. 92, a total of 2897 cases of head injuries were registered in the seven study hospitals of Bangalore city. Among these, 2062 (71.5%) cases were registered at NIMHANS. All other hospitals included, registered a total of 835 (22.4%) cases. Table 9 shows the distribution of head injury registration across different months.

Table 9 .Incidence of Head Injuries

Place	Sept.	oct.	Nov.	Dec.	Jan.	Feb.	Total
Nimhans	301 (66.7)	381 (70.3)	316 (67.2)	346 (73.6)	366 (74.1)	352 (74.9)	2062 (71.2)
Victoria hospital	41 (9.1)	29 (5.4)	30 (6.4)	23 (4.9)	20 (4.0)	35 (7.4)	178 (6.1)
SGARC	31 (6.9)	34 (6.3)	40 (8.5)	26 (5.5)	34 (6.9)	16 (3.4)	181 (6.2)
St.John,s hospital	25 (5.5)	44 (8.1)	37 (7.9)	28 (8.1)	30 (6.1)	35 (7.4)	199 (6.9)
MSRamaiah hospital	15 (3.3)	14 (2.6)	12 (2.6)	16 (3.4)	12 (2.4)	8 (1.7)	77 (2.7)
St.Martha,s hospital	16 (3.5)	24 (4.4)	20 (4.3)	21 (4.5)	17 (3.4)	10 (2.1)	108 (3.7)
KCG hospital	22 (4.9)	16 (3.0)	15 (3.2)	10 (2.1)	15 (3.0)	14 (3.0)	92 (3.2)
Total	451 (100.0)	542 (100.0)	470 (100.0)	470 (100.0)	494 (100.0)	470 (100.0)	2897 (100.0)

It was possible to collect total information from 2515 cases (87.3%) through direct interviews. In the remaining 382(12.8%) cases, information on all aspects was collected by a combination of interviews, medical and police records. The reasons for this were non availability of information as the patient was brought by unknown persons / police in 327 (11.4%) cases, uncooperative patients 6(0.3%) and immediate referral to another hospital in 49 (1.7%) cases. The problem of collecting information was more during night times and injuries due to assault.

The location of injured person according to place of residence revealed that 2143 individuals were residents within the city of Bangalore and had met with head injuries within city limits. The remaining group comprised of individuals meeting with head injuries outside the city but registered in the city for treatment. Among these, 318 were residents of the city and 436 were nonresidents of the city. Hence, a total of 2461 cases were registered among city residents, thus giving a head injury incidence rate of 60.2 per 1,00,000 for the period of 6 months during 1991-92 with a corresponding annual incidence rate of 120.4 per year per 100,000 population.

Table 10 - Age - sex distribution

Age in yrs	Male	Female	Total
0-4	83 (3.8)	60 (8.8)	143 (4.9)
5-9	172 (7.8)	97 (14.3)	269 (9.3)
10-14	141 (6.4)	49 (7.2)	190 (6.6)
15-19	181 (8.2)	42 (6.2)	223 (7.7)
20-24	324 (14.7)	58 (8.5)	382 (13.2)
25-29	318 (14.4)	65 (9.4)	383 (13.3)
30-34	238 (10.8)	47 (6.9)	285 (9.9)
35-39	216 (9.8)	47 (6.9)	263 (9.1)
40-44	130 (5.9)	37 (5.4)	167 (5.8)
45-49	110 (5.0)	52 (7.7)	162 (5.6)
50-54	95 (4.3)	28 (4.1)	123 (4.3)
55-59	57 (2.6)	30 (4.4)	87 (3.0)
60-64	46 (2.4)	23 (3.4)	69 (2.4)
65 +	96 (4.4)	45 (6.4)	144 (4.9)
Not known	7 (0.4)	3 (0.4)	10 (0.4)
Total	2214 (100.00)	683 (100.00)	2897 (100.00)

Male to female ratio = 1 : 0.3

The age - sex distribution of head injury cases is shown in table - 10 .Figures 5 and 6 reveal the association between age and cause of head injuries. The highest number of head injuries had occurred in 20-30 years age group constituting 765 (26.5%) cases. Children in the age group of < 15 years accounted for 20.8 % of cases and individuals above 60 years constituted 7.3% of total cases. Within the age group of 15-60 yrs individuals in the age group of 20-30 years accounted for 26.5% of total cases. The male to female distribution was in the order of 1 : 0.3. Interestingly, among both children and elderly, females were more as compared to males. ( Children - males (18.0%) : Females (30.3%) and ( elderly - males (6.5%) : females(9.8%), While in all other age groups males outnumbered females substantially.

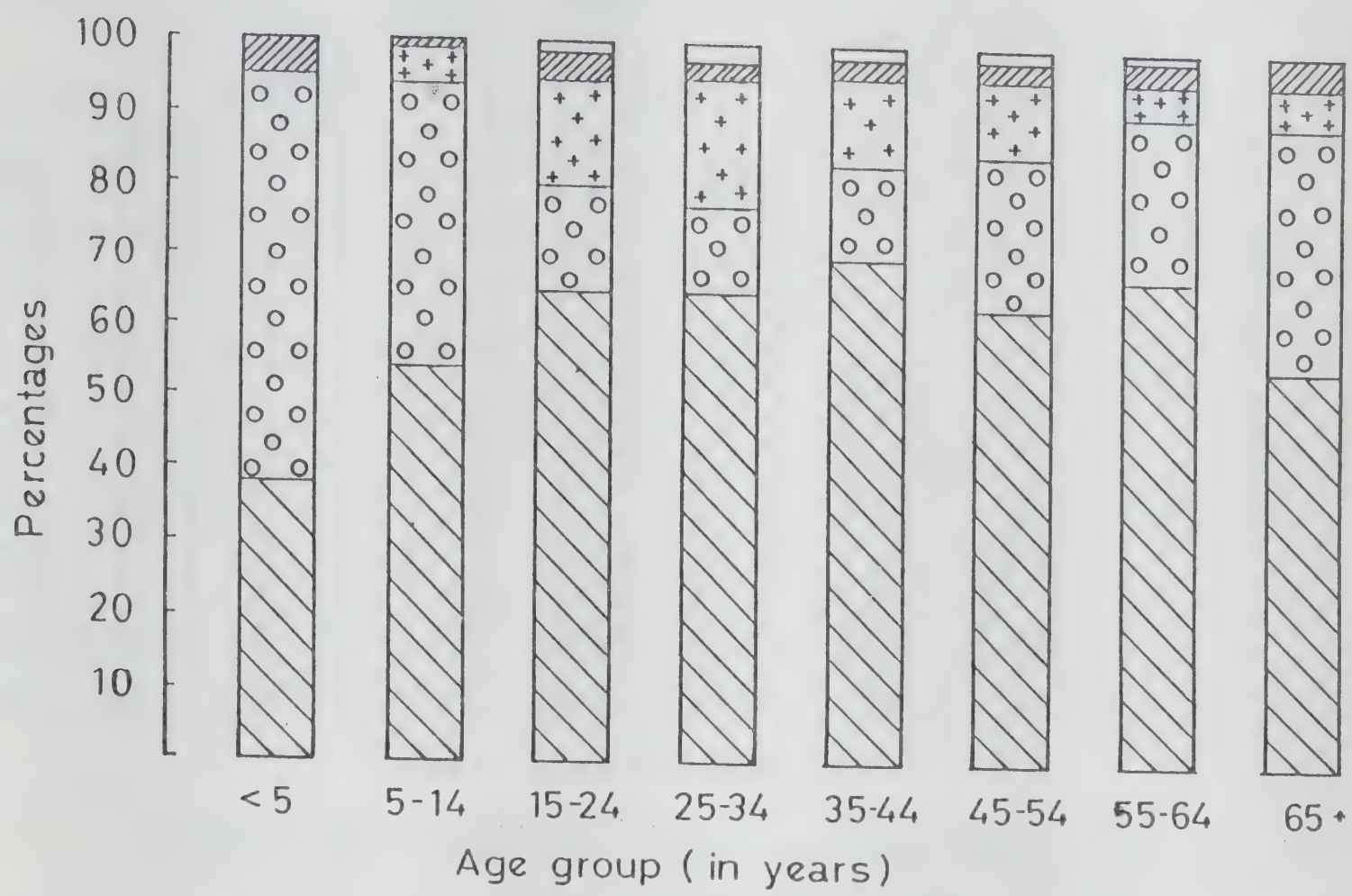
### 11.3 Socio economic characteristics

Table 11: Educational status of head injury cases

----- Educational status -----	No.	%
Illiterate	562	19.4
Primary	446	15.4
Secondary	336	11.6
High School	563	19.4
Pre-University	165	5.7
Graduate	185	6.4
Post-graduate	131	4.5
Professional	188	6.5
Not applicable	168	5.8
Not known	153	5.3
	----- 2897 -----	----- 100.0 -----

Table 11 shows the educational status of head injury patients. Illiterates, upto <10 years of education and above high school levels of education (>10 levels ) consisted of 562 (19.4%),1345 (46.4%) and 669 (23.1%) cases respectively. Thus, it can be seen clearly that more number of educated people had met with head injuries (69.5%).

# 5. CAUSE OF HEAD INJURY MORBIDITY IN VARIOUS AGE GROUPS



- Road traffic accidents
- Falls
- Assault
- Fall of objects
- Others

## 6. CAUSE OF HEAD INJURY MORTALITY IN VARIOUS AGE GROUPS

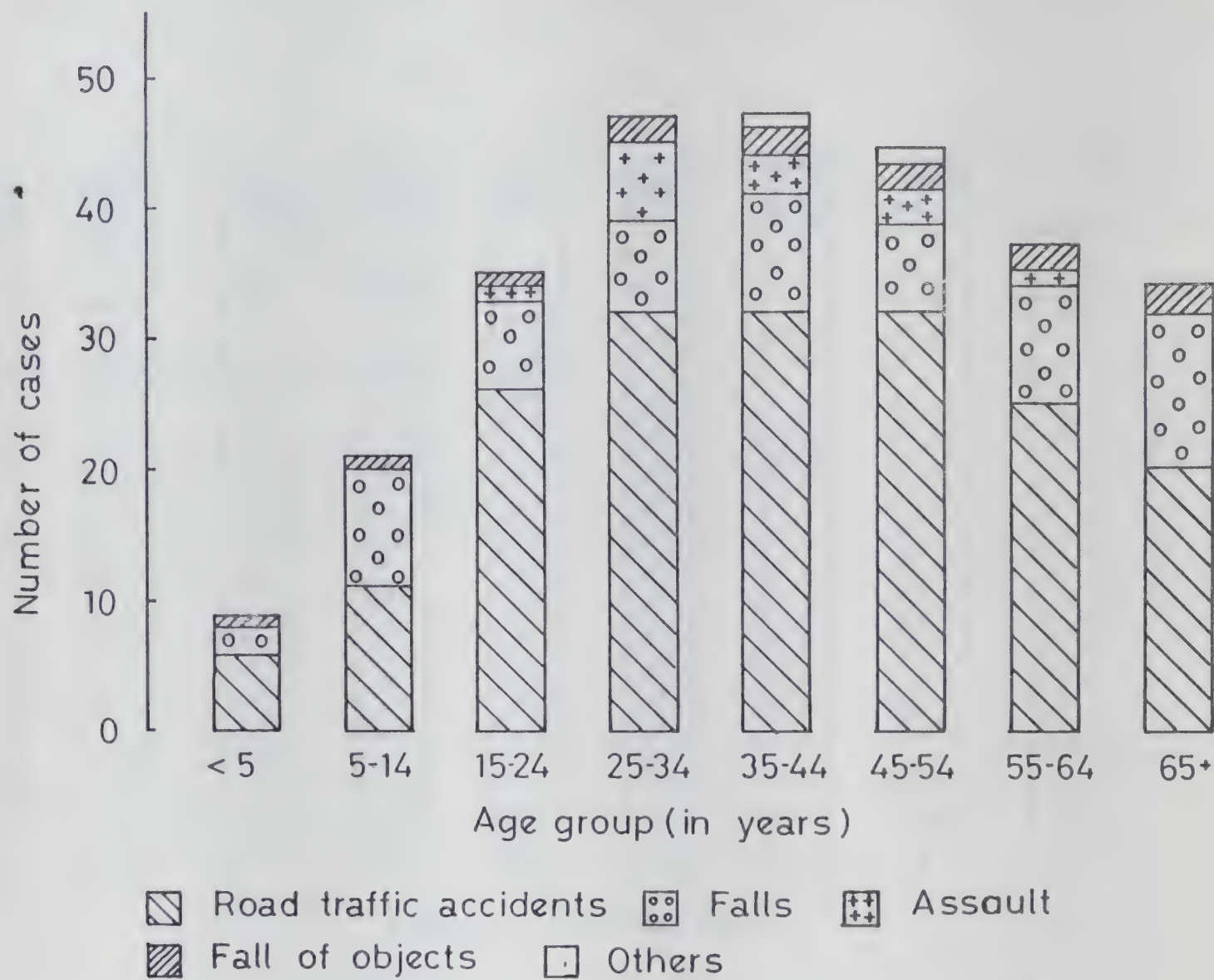


Table 12 : - Occupational status

Occupational status	No.	%
Professional, technical & related workers	83	2.9
Administrative, executive & managerial workers	114	3.9
Sales and Business workers	218	7.5
Agricultural workers	307	10.6
Quarry and construction workers	48	1.7
Transport and communication sector workers	147	5.1
Production Process workers	434	15.0
Service, Sport and recreation workers	105	3.6
Workers without Occupation	86	3.0
Students	542	18.6
Housewives	269	9.3
Not applicable	197	6.8
Not Known	347	12.0
Total	2897	100.00

We used the occupational categories as per the ICMR guidelines. It can be noticed from table 12 that students, production process workers and agricultural workers ranked the first three groups in the order of 18.6%, 15.0% and 10.6% respectively. About 6.8% of cases were constituted by people working in professional, technical and administrative cadres. Transport sector workers, service grade employees and housewives constituted 5.1%, 3.6% and 9.3% respectively. This signifies that head injuries were common in the productive strata of society.

Information on Income of the family per month has been provided in table 13.

Table 13 : - Family income

Income groups (Rs.per month)	No	%
< 500	323	11.2
501 - 1000	848	29.3
1001 - 1500	449	15.5
1501 - 2000	248	8.6
2001 - 2500	274	9.5
2501 - 3000	136	4.7
> 3000	272	9.4
Not Known	347	11.8
Total	2897	100.00

The information given above reveals that about 40.5% and 38.3% of victims belonged to families with an income of less than < Rs. 1000 per month and between Rs. 1001 - 3000 per month. Only 9.4% victims were from families with an income of > Rs. 3000 per month and information was not available in 11.8% of cases.

\*\*\*\*\* Distribution of cases according to religion revealed that hindus, muslims and christians constituted 81.6%, 11.0% and 3.8% respectively. Information on religion was not available in 3.2% of cases.

\*\*\*\*\* About 1376 cases (47.5%) belonged to smaller families of less than 6. Only 115 cases were from larger families of more than 10 (3.9%).

\*\*\*\*\* The marital status of victims at the time of injury revealed that about 1245 (43.0 %) were married, 801 (27.7 %) were unmarried and 81 (2.8 %) were living alone.

#### 11.4 ALCOHOL, DRUGS AND HEAD INJURIES:

All over the world, alcohol and drugs have been found to be major responsible factors for the occurrence of head injuries. The results from our study have shown interesting evidence about the role of alcohol.

\*\*\*\*\* Smoking was a common habit among our patients noticed in the study. In the total sample, 739 cases (25.5%) reported current smoking. On specific investigation of smoking among men aged 15 years and above, the practice of smoking was present in 45% of cases with varying duration. We did not encounter any case due to consumption of hazardous, abusive drugs which have been incriminated in the occurrence of head injuries.

A positive history of habitual consumption of alcohol was observed in 532 cases (19.4%). Among these cases, about 258 (9.4 %) were under the intoxicating effects of alcohol at the time of injury occurrence. This information is provided in table 14.

Table 14 : Alcohol consumption and head injuries  
(n=2743)

	No.	%
Individuals without habit of consuming alcohol.	2211	80.6
Individuals with habit of consuming alcohol but not consumed prior to injury	274	10.0
Individuals with history of alcohol consumption prior to the occurrence of head injury.	258	9.4

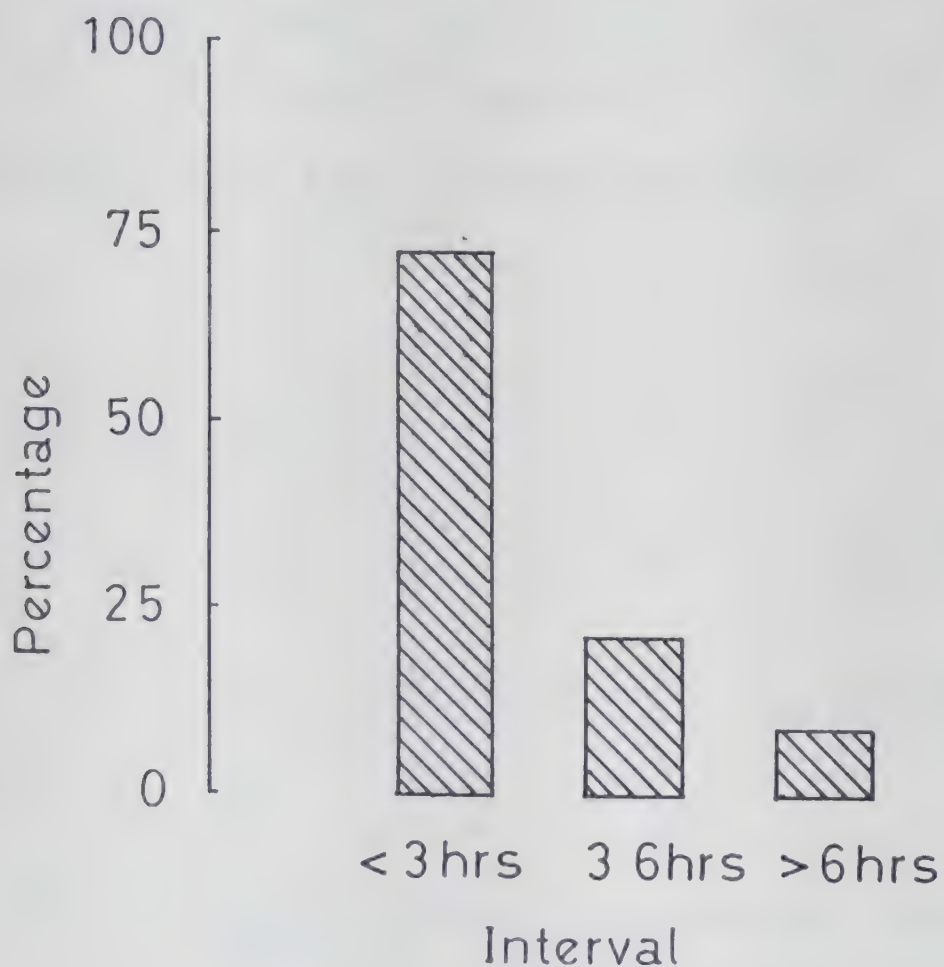
Table 15 : Alcohol consumption in adolescents and above  
(n=1664)

Not in the habit of consuming alcohol	1132	68.0
not consumed prior to injury occurrence	274	16.5
consumed alcohol prior to injury occurrence	258	15.5

Among individuals above the age of 15 years ,about 532 (100.0) reported regular consumption of alcohol. Among them 258(49.5 %) had consumed alcohol prior to the occurence of injury (figure 7).

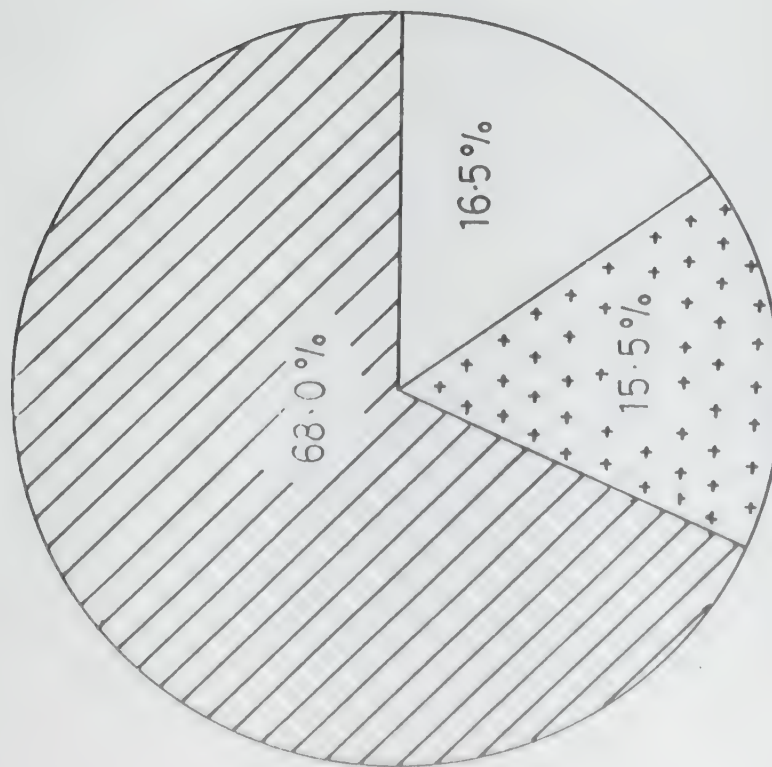
The Interval between alcohol consumption and injury occurence is given in figure 8.

#### 8. INTERVAL BETWEEN ALCOHOL CONSUMPTION AND HEAD INJURY.

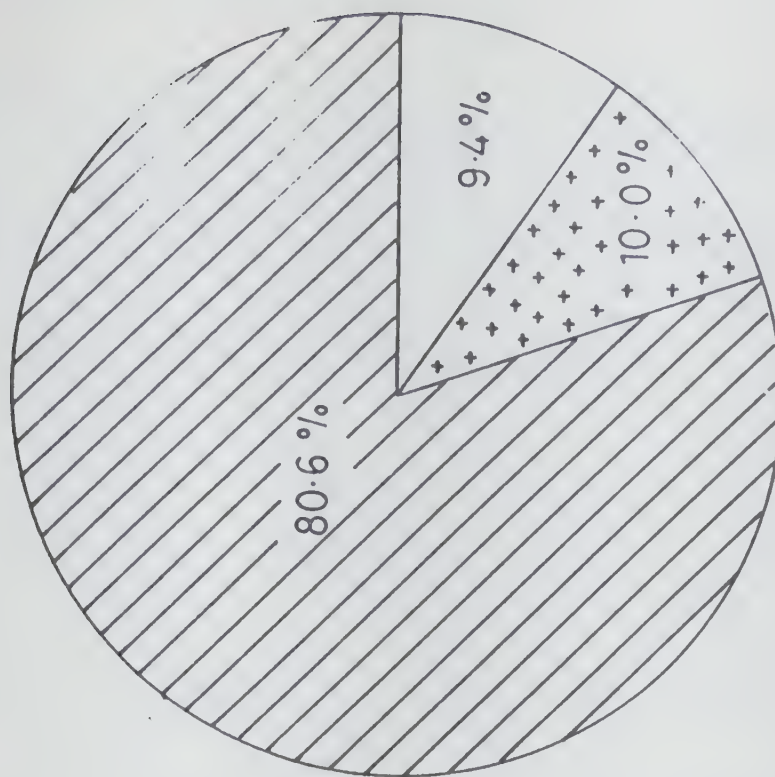


It can be seen that about 72.1% of cases had consumed alcohol in the past 3 hours prior to head injury occurence. Only 7.4% had a duration of more than 6 hours.

# 7. ALCOHOL CONSUMPTION AND HEAD INJURIES



Individuals 16 years and above



Total cases

Alcohol not as a habit

With habit but not consumed

With habit and consumed



The relation between alcohol and Cause of Head Injury is shown in table 16.

Table 16 :? Alcohol and Cause of Injuries

	RTAS	Falls	Assault	Others	Total
Alcohol consumption positive	160 (14.8)	60 (19.6)	36 (17.2)	2 (2.9)	258 (15.5)
Alcohol consumption negative	920 (85.2)	246 (80.4)	173 (82.8)	67 (97.1)	1406 (84.5)
Total	1080 (100.0)	306 (100.0)	209 (100.0)	69 (100.0)	1664 (100.0)

From table 16, it is evident that alcohol contributed for 14.8 % of road accidents, 19.6 % of falls and 17.2 % of assaults among specific categories. The proportion of falls was higher among those who had consumed alcohol ( 23.3 % ). The proportion of road accidents , falls and assaults among those who had consumed alcohol was 62.0 % , 23.3 % and 14.0 % respectively.

### 11.5 : COMORBID CONDITIONS

Several comorbid conditions have been found to be associated with head injuries. We observed the following in our case series.

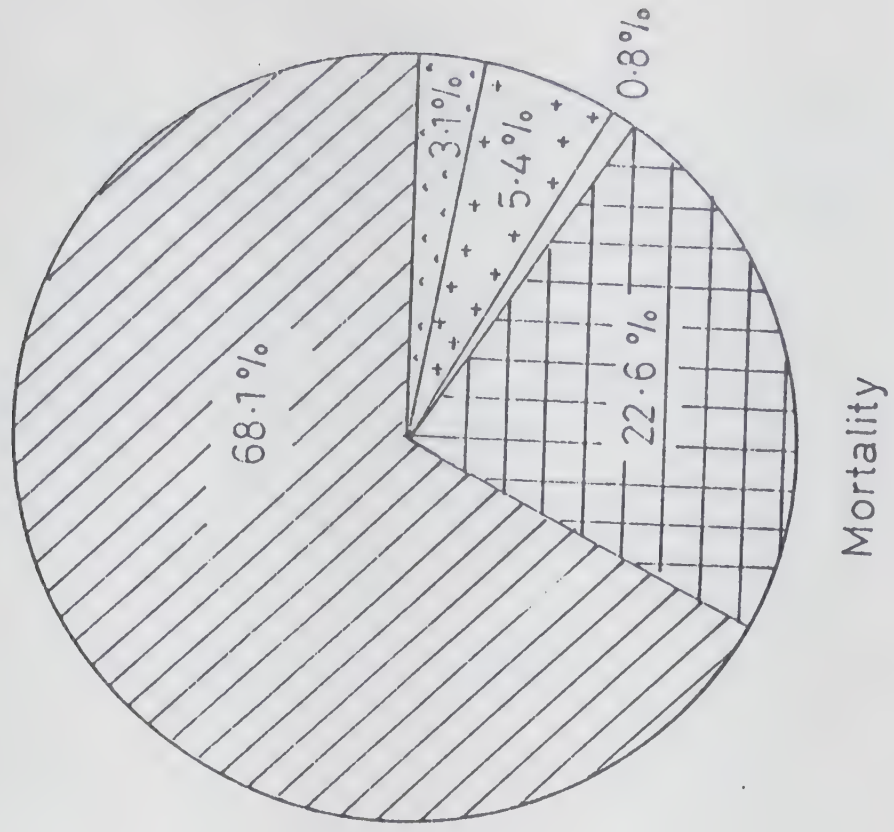
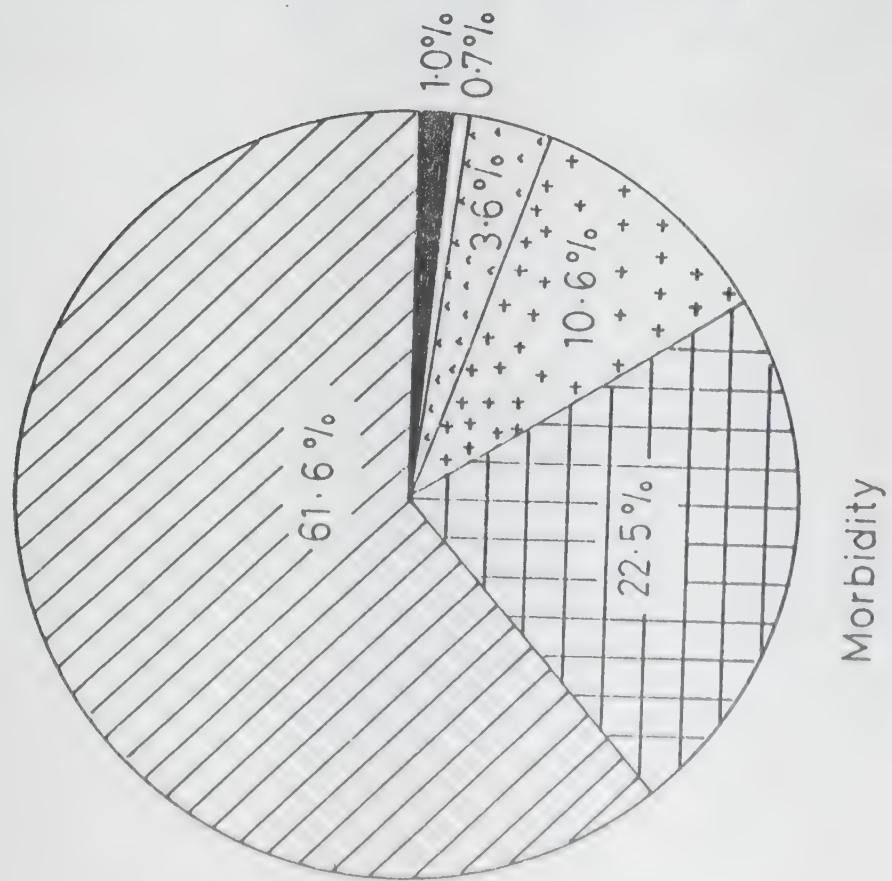
Table 17 : Associated comorbid conditions

condition	No.	%
Hearing problem	82	3.2
Vision Problems	95	3.8
Physical Disability	16	0.6
Diabetes Mellitus	34	1.3
Hypertension	77	3.0
Epilepsy	70	2.8
Mental Retardation	11	0.4
Mental Illness.	9	0.4
Hyperacidity	26	1.0
Respiratory Problems	22	0.9
Miscellaneous	34	1.3

Among the several comorbid conditions, hearing problems (3.2%), vision problems (3.8%), Hypertension (3.0%) and epilepsy (2.8%) constituted the major conditions. A large number of other conditions were also identified. About 16 (0.69%) cases had physical disability due to previous injuries and infections. Majority of these individuals were on treatment for their illness. About 31 (37.8 %) individuals with hearing problem, 21 (22.1 %) with visual problems, 10 (13.0 %) hypertensives and 23 (32.9 %) epileptics were not on any treatment and care at the time of head injury occurrence. Majority of those with mental disorders were also not on any care as reported by them.

\*\*\*\*\* A previous history of head injury was observed in 46 cases (1.7%) during the past 5 years. This information was collected for individuals above the age group of 5 years only.

## 9. CAUSES OF HEAD INJURY





### 11.6 CAUSE OF HEAD INJURIES:

During the period September 91 - February 92, a total of 2897 cases of head injuries were registered in various hospitals of Bangalore city, the cause for which is also shown in figure 9.

Table 18 : Cause of head injuries

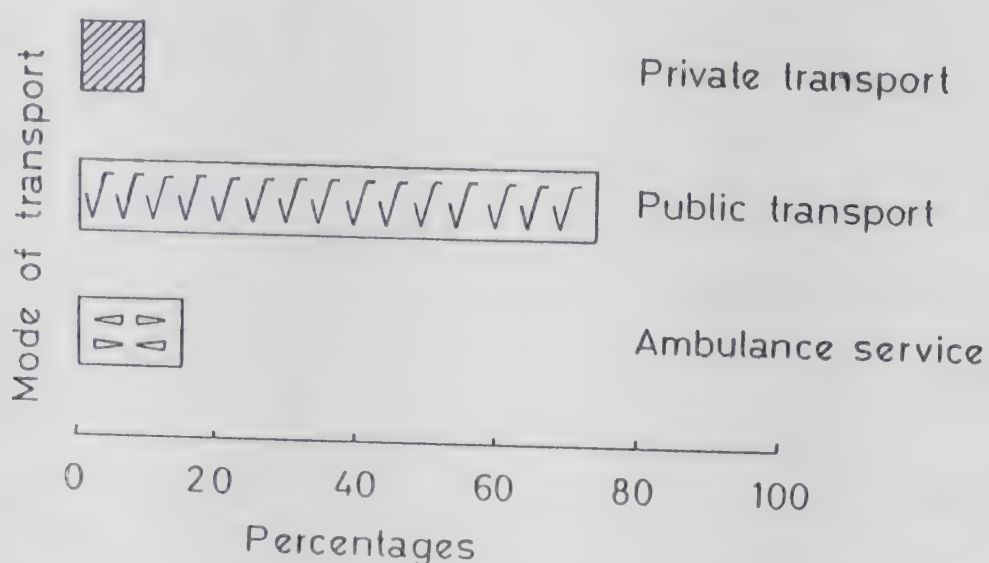
Road Traffic Accidents	1784	61.6%
Falls	651	22.5%
Assault	307	10.6%
Fall of an object	103	3.6%
Industrial Accidents	21	0.7%
Not Known	31	1.0%
Total	2897	100.00

Information on cause of head injuries is very useful for any activity aimed at care, prevention and rehabilitation. The table /figure reveals that road traffic accidents accounted for 1784 (61.6%) cases. Head Injuries due to falls at various places was observed in 651( 22.5% ) cases . Assaults and fall / hit by an external object constituted 307(10.6%) and 103(3.6%) cases respectively. Industrial accidents with head injuries were recorded in 21(0.7%) of cases. In 31(1.0%) cases the cause of head injury was not known to any informant and could not be elicited.

## 11.7 MODE OF ARRIVAL

The mode of arrival was predominantly through public transport in 1895 cases (65.4%), followed by Ambulance services in 432 cases (14.9%). Since private transport was available with only a few people, it was utilised for transporting the patient in 12.5% of cases (figure 10).

### 10. MODE OF TRANSPORT FOR HEAD INJURY PATIENTS



The mode of arrival in different situations due to different causes is shown in table 19.

Table 19 : Mode of arrival and cause

	RTA	Falls	Assault	FOB	Others	Total
Ambulance	308 (17.3)	65 (10.0)	42 (13.7)	13 (12.6)	5 (23.8)	432 (15.1)
Public	1161 (65.1)	461 (70.8)	199 (64.8)	66 (64.1)	7 (33.4)	1895 (66.1)
Private	162 (9.1)	66 (10.1)	20 (6.5)	11 (10.7)	4 (19.0)	263 (9.2)
Others	42 (2.3)	15 (2.3)	8 (2.6)	2 (1.9)	5 (23.8)	72 (2.5)
NA	111 (6.2)	44 (6.8)	38 (12.4)	11 (10.7)	-	204 (7.1)
Total	1784	651	307	103	21	2866

It can be seen from table 20 that the utilisation of ambulance services was high in industrial accidents (23.8%) and road traffic accidents (17.3%) , while it was very poor in falls (10.0%). Reliability on public transport was more in falls (70.8%) as compared to any other cause. The table clearly shows the dependency and utilisation of public transport services in 66% of cases.

### 11.8 DAY AND TIME OF HEAD INJURY OCCURENCE

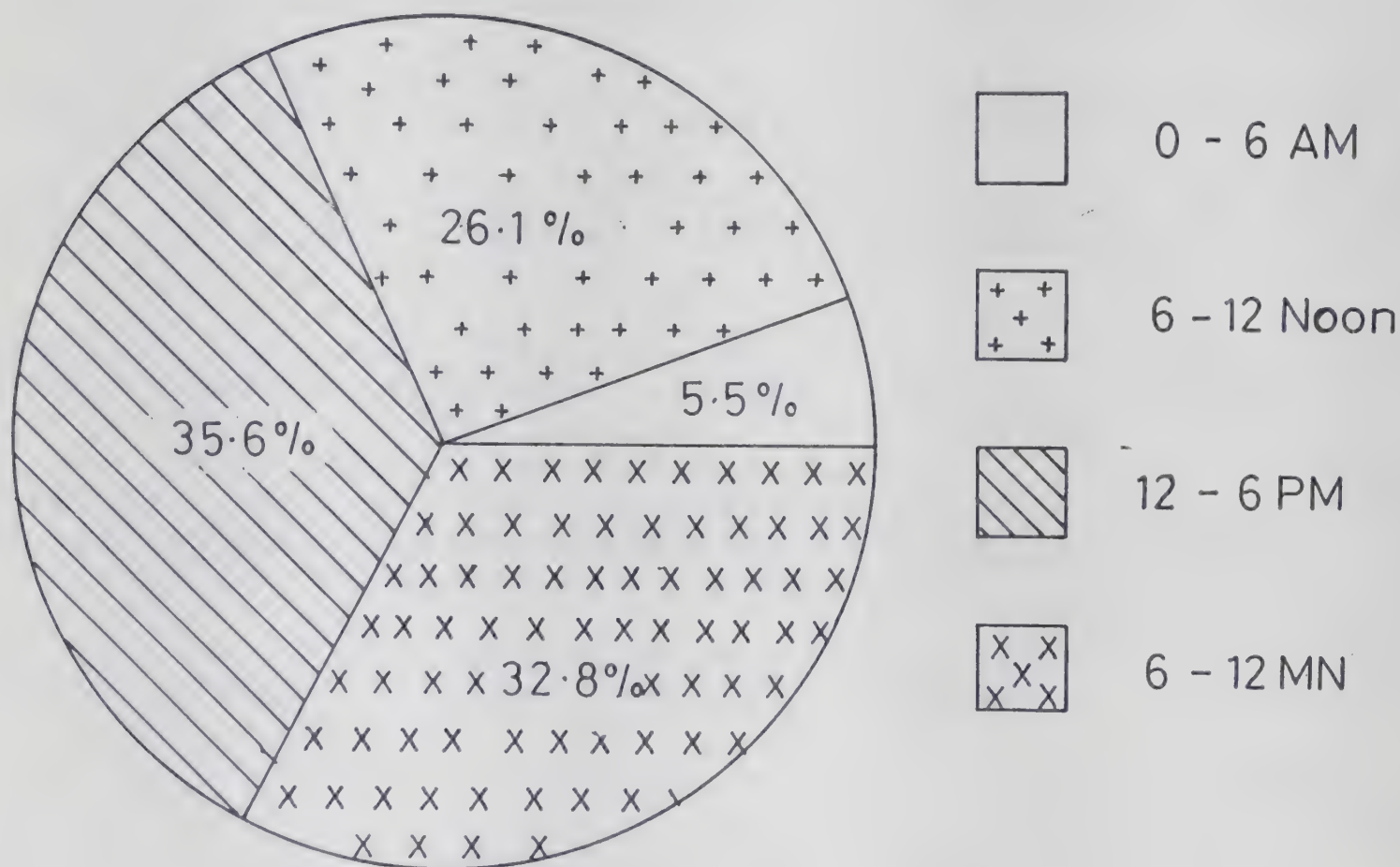
Table - 20 : Day of head injury occurence

	RTA	Fall	Assault	FOB	IA	Total
Mondays	279 (15.7)	104 (16.1)	51 (16.9)	20 (19.6)	1 (5.3)	455 (16.0)
Tuesdays	271 (15.3)	90 (13.9)	29 (9.6)	11 (10.8)	1 (5.3)	402 (14.1)
Wednes- days	260 (14.7)	81 (12.5)	37 (12.3)	17 (16.7)	1 (5.3)	396 (13.9)
Thurs- days	251 (14.2)	106 (16.4)	39 (12.9)	14 (13.7)	6 (26.3)	416 (14.6)
Fridays	205 (11.6)	83 (12.8)	45 (14.9)	18 (17.6)	6 (26.3)	357 (12.6)
Satur- days	249 (14.1)	89 (13.8)	56 (18.5)	10 (9.8)	1 (5.3)	405 (14.2)
Sundays	257 (14.4)	93 (14.4)	45 (14.9)	12 (11.8)	5 (26.3)	411 (14.5)
	1772 (100.0)	646 (100.0)	302 (100.0)	102 (100.0)	21 (100.0)	2843 (100.0)

Table 20 reveals the pattern of head injury occurrence on different days of the week. Clearly, Mondays registered the highest number of cases (16.0%) . Road Traffic accidents also occurred in high numbers on Mondays (15.7%) and Tuesdays (15.3%). Highest number of falls were recorded on Mondays (16.0%) and Thursdays (16.3%). Assaults were more commonly noticed on Saturdays to the extent of 18.5 %.. Conversely Industrial accidents were more in the latter half of the week as compared to other causes.

The time of occurrence of injuries is shown in figure 11.

## 11. TIME OF OCCURENCE OF HEAD INJURIES



It can be seen that 1007 head injuries had occurred between 12 noon - 6 PM to the extent of 35.6% , followed by evenings and early nights in 927(32.8%) cases. Similarly, mortality was also high among head injuries occurring between 12 noon to 12 midnight to the extent of 65.3 %.

21. Time of occurrence and cause of head injuries is shown in table

Table 21 : Cause and time of head injury occurrence

Time	RTA	Falls	Assaults	FOB	IA	Total
12 MN -6AM	91 (5.1)	21 (3.3)	28 (9.4)	12 (11.8)	4 (19.1)	156 (5.5)
6 AM -12Noon	479 (27.1)	168 (26.1)	61 (20.5)	24 (23.8)	6 (28.6)	738 (26.1)
12 Noon-6 PM	582 (32.9)	287 (44.6)	95 (32.0)	35 (34.7)	8 (38.1)	1007 (35.6)
6 PM -12 MN	614 (34.8)	167 (26.0)	113 (38.1)	30 (29.7)	3 (14.2)	927 (32.8)
Total	1766 (100.0)	643 (100.0)	297 (100.0)	101 (100.0)	21 (100.0)	2828 (100.0)

It can be seen that maximum number of road accidents and assaults had occurred between 6 PM - 12 MN to the extent of 34.8% and 38.1% respectively, followed by 12 Noon - 6 PM to the extent of 32.9% and 32.0% respectively. Falls and fall of objects were more common between 12 noon - 6 PM to the order of 44.6% and 34.7% respectively. Industrial accidents were more common during afternoon and mornings.

### 11.9 PLACE OF OCCURRENCE OF HEAD INJURIES

Since all road traffic accidents had occurred on the roads, information on this aspect is provided only for domestic falls, fall of an object and assaults. Similarly information on industrial accidents pertain to their occurrence within the industries.

Table 22. Place of occurrence of head injuries

place	Fall	Assault	FOB	Total
Road	76 (11.6)	84 (27.4)	13 (12.6)	173 (16.3)
Industrial work site	5 (0.8)	8 (2.6)	3 (2.9)	16 (1.5)
Construc- tion site	32 (4.9)	3 (1.0)	8 (7.8)	43 (4.1)
Domestic	442 (67.9)	141 (45.9)	51 (49.5)	634 (59.8)
Play site	20 (3.1)	2 (0.7)	10 (9.7)	32 (3.0)
Agricul- tural land.	40 (6.1)	20 (6.5)	5 (4.8)	65 (6.1)
Others	36 (5.5)	49 (15.9)	13 (12.6)	98 (9.2)
Total	651 (100.0)	307 (100.0)	103 (100.0)	1061 (100.0)

The domestic sites were mainly responsible for majority of head injuries due to any given cause apart from road accidents. (67.9 %). Assaults were more common in houses and on roads to the extent of 45.9 % and 27.4 %. Similar pattern was noticed for fall of objects also. Falls and fall of objects were also a common mode of injuries at construction sites.

#### 11.10. INTERVAL BETWEEN INJURY AND MEDICAL CONTACT

The interval between time of occurrence of head injury and reaching a medical source is an important step in protecting the life of a person. We noticed in our study that about 94.5% of cases had received immediate medical help within 3 hours after the occurrence of injury.

Table 23 :Interval between head injury & medical contact

Hours	First medical contact		Study centre	
	No.	%	No.	%
< 1 hour	2505	86.5	697	24.1
1 - <3 hours	262	9.0	883	30.5
3 - <6 hours	66	2.3	549	19.0
6 - <12 hours	26	0.9	314	10.8
>12 hours	38	1.3	454	15.7
Total	2897	100.0	2897	100.0

It can be seen that majority of the cases had contacted a health care agency within 3 hours, irrespective of the cause. Only about 5.0% of cases had reported beyond 3 hours. However, only around 54.5 % of cases were able to reach a multidisciplinary trauma care hospital within 3 hours and 26.5 % cases could reach only after 6 hours.

Further analysis of the same according to various causes revealed that about 50% of road accidents had reached a definitive hospital within 3 hours and about 30% beyond 6 hours. In case of head injury due to falls and assaults, more than 50% had reached beyond 3 hours. Because of good facilities available in industrial establishments about 76.3% had reached a definitive hospital within 3 hours.

#### 11.11. First aid services and referral information:

First aid services provided immediately after the injury at or near the site of accident helps a long way in saving the life of victims and reducing complications associated with head injuries. Table 25 provides clear information by emphasizing that only 13.3% received some first aid and 86.7% did not receive any first aid services.

Table 24 : First aid services provided at accident site

	No.	%
Provided	355	13.3
Not provided	2303	86.7
Total	2897	100.0

Among the 355 patients, who had received first aid services, it was mainly provided by different people as shown in table 25.

Table 25 : Source of first aid services

source	No.	%
Doctor	294	83.1
Health Worker	7	2.0
Family Members	19	5.4
Public	27	7.6
Others	8	1.9
Total	355	100.0

The local general practitioners had provided immediate first aid in 83.1% of cases. It was interesting to note that for 13.0% of cases the family members and public had provided services but was not possible to establish the quality of services. Further analysis into the cause of head injuries and receiving first aid services revealed that the local doctor had administered the first aid services irrespective of the cause in majority of the instances. Health workers contribution was less ( 2.0%) as compared to public and family members (13.0%).

The source of referral in various causes is shown in Table-26

Table 26 :Source of referral to the study hospitals

Source	RTAs	Falls	Assault	FOB	IA	Total
General practitioners	135 (7.8)	106 (16.9)	16 (5.7)	11 (11.0)	-	268 (9.7)
Nursing homes	152 (8.8)	85 (13.5)	9 (3.2)	13 (13.0)	4 (22.2)	263 (9.5)
Local Hospitals	109 (6.2)	53 (8.4)	12 (4.2)	9 (9.0)	2 (11.1)	185 (6.7)
Govt. hospitals	892 (51.5)	235 (37.4)	183 (64.7)	47 (47.0)	2 (11.8)	1359 (49.2)
Sanjaya Gandhi hospital	54 (3.1)	15 (2.4)	10 (3.5)	1 (1.0)	-	80 (2.9)
Directly on their own	372 (21.5)	125 (19.9)	53 (18.7)	19 (19.0)	10 (55.6)	579 (21.0)
Others	19 (1.1)	9 (1.4)	-	-	-	28 (1.0)
Total	1733 (100.0)	628 (100.0)	283 (100.0)	100 (100.0)	18 (100.0)	2762 (100.0)

The referral pattern reveals that Government Hospitals had referred a total of 1359 (49.2%) cases. About 519(21.0%) cases had come directly to the study hospitals on their own. General Practitioners, Nursing Homes and local hospitals had referred 268(9.7%), 263(9.5%) and 185 (6.7%) cases respectively. It can be seen that among road accidents and falls that SGARC referred only 3.1% of cases since specialised neurosurgical care was available in this place.

### 11.12 : EXPENDITURE INCURRED TILL REACHING HOSPITAL

Direct costs in terms of travel, amount paid for services earlier, local stay till the patient reached one of the sentinel hospitals was developed to know the expenditure incurred due to head injuries. Table 27 shows details on this issue.

Table 27 : Expenditure at hospital entry time

Amount in Rupees	No.	%	cum.total
< 300	2354	81.3	81.3
301 - <600	273	9.4	90.7
601 - <900	84	2.9	93.6
901 - <1200	64	2.2	95.8
1201 -<1500	44	1.5	97.3
> 1500	78	2.7	100.0
Total	2897	100.0	

It can be seen that majority of the patients had spent less than Rs. 300 ( \$ US 10 ) till they arrived at the hospital. Only 2.7% had spent more than Rs. 1500 ( \$ US 50) at the time of admission. This was also uniform across different causes .

### 11.13 : ROAD TRAFFIC ACCIDENTS

During the study period of 6 months, a total of 1784 cases of head injuries due to road traffic accidents were registered, contributing for 61.6% of total head injuries. The present section goes indepth into certain specific aspects.

### 11.13.1 : Location of road traffic accidents

To develop this information the place of RTA's was divided under the following categories.

Table 28 : Location of road accidents

Location	No.	%
Highway accidents	361	20.2
Accidents within the city of Bangalore.	1157	64.9
Accidents outside the city of Bangalore.	266	14.9
Total	1784	100.0

The precise point where injury had occurred is shown in table 28.1.

Table 28.1 : Location of Injury

Location	No.	%
Highway circles	48	13.3
Highway main roads	283	78.4
Highway cross roads	30	8.3
Total	361	100.0
Within city areas:		
Circles	68	5.9
Near Traffic Signal Points	86	7.4
City Main roads	594	51.3
City cross roads	110	9.5
Near Bus stops	73	6.3
Playsite	22	1.9
Near Railway Tracks	17	1.5
Not known (unspecified)	187	16.2
Total	1157	100.0%



It can be seen that most of the road accidents had taken place on the main roads both on highways and within the city in majority of cases.

It can be seen that about 361(20.2%) RTA's had occurred on highways originating from or leading towards Bangalore. About 1157 (64.9%) and 266 (14.9%) had occurred within and outside the jurisdiction of the city of Bangalore.

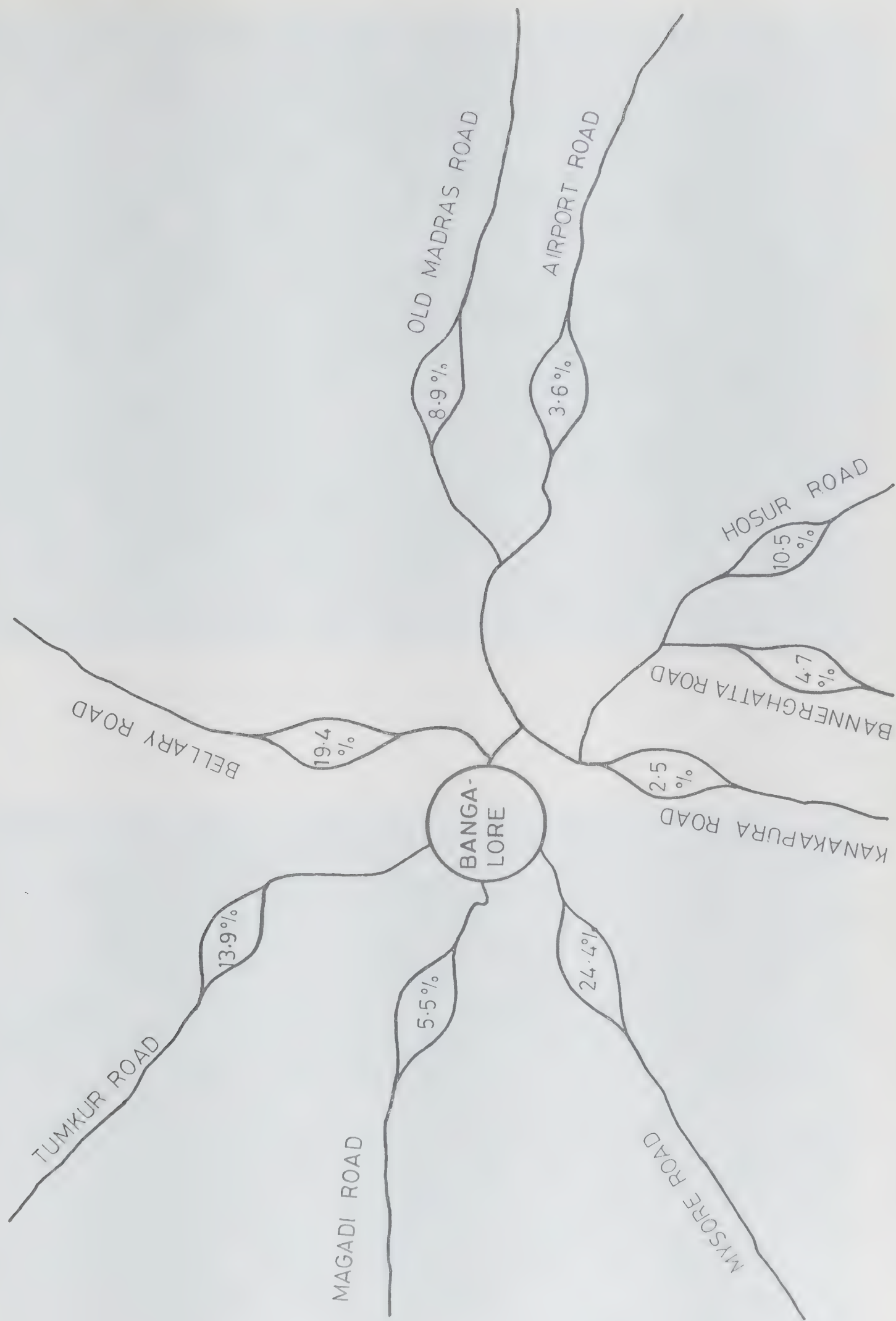
The city of Bangalore has 10 different highways originating or passing through or leading towards the city. Each of these highways had contributed differently for head injury occurrence. Information regarding head injury occurrence on different highways is shown in figure 12.

Table 29 : Highways and Head injuries

Highway	No.	%
Bangalore - Mysore Road	88	24.4
Bangalore - Bellary Road	70	19.4
Bangalore - Tumkur Road	50	13.9
Bangalore - Hosur Road	38	10.5
Bangalore - Old Madras Road	32	8.9
Bangalore - Hassan Road	24	6.6
Bangalore - Kolar Road	20	5.5
Bannerghatta Road	17	4.7
Bangalore - Sarajpur Road.	13	3.6
Other Highways	9	2.5
Total	361	100.0

It can be seen that Bangalore - Mysore road tops the list in the casualties to the extent of 24.4% followed by Bangalore - Bellary Road to the extent of 19.4%. Third in the order was Bangalore - Tumkur Road to the extent of 13.9% followed by Hosur Road ( 10.5%).

FIGURE 12. HIGHWAY DISTRIBUTION OF HEAD INJURIES









The city of Bangalore has been divided into 71 divisions as per the maps prepared by KSCST by taking into account the administrative divisions. We identified the area of highest head injury occurrence in the city by using this map. Accordingly almost all areas had head injuries and in the following table, 10 major areas as per the rank order has been presented. The boundaries of these areas correspond with the maps prepared by KSCST. This does not take into account the high way accidents and injuries occurring outside the city .

Table 30 :Geographical distribution of head injuries

Area Name	No.	%
Sampangiram Nagar	61	5.5
Subash Nagar	53	4.9
Rajajinagar	50	4.5
Wilson Garden	46	4.2
Malleswaram	44	4.0
Shivajinagar	43	3.9
Ulsoor	33	3.0
Jayanagar	33	3.0
K.R. Market	29	2.6
Lingarajapuram	28	2.5
Total	420	38.1

Among these 10 areas, it is clear that Sampangiram Nagar, Subash Nagar and Rajajinagar contributed for 5.5%, 4.9% and 4.5% of head Injuries respectively.

### 11.13.2 : Mode of Accidents

The mode of injuries was determined by using the ICD 9 classificatory procedures as per the external causes.

Table 31 : Mode of road traffic accidents

Mode of Injury	Injured	Killed	Total
1. Railway accidents	3 (0.2)	3 (1.6)	6 (0.3)
2. Motor Vehicle accident including collision with another motor vehicle	441 (27.6)	40 (21.7)	481 (27.0)
3. Motor vehicle accident involving collision with stationary vehicle	25 (1.6)	1 (0.5)	26 (1.5)
4. Motor vehicle accident involving collision with animal drawn vehicles	74 (4.6)	3 (1.6)	77 (4.3)
5. Motor vehicle accident involving collision with a pedestrian	459 (28.7)	68 (36.9)	527 (29.5)
6. Motor vehicle accident involving collision with stationary objects on the road	37 (2.3)	1 (0.5)	38 (2.1)
7. Motor vehicle accident due to loss of control	217 (13.6)	17 (9.2)	234 (13.1)
8. Motor vehicle accident while boarding or alighting from a vehicle	127 (7.9)	15 (8.1)	142 (8.0)
9. Motor vehicle accident due to hit by parts of a vehicle while in motion	7 (0.4)	-	7 (0.4)
10. Pedal cycle accidents	136 (8.5)	8 (4.3)	144 (8.1)
11. Unspecified MVA	74 (4.6)	28 (15.2)	102 (5.7)
Total	1600 (100.0)	184 (100.0)	1784 (100.0)

It is obvious from table 31 that collision of motor vehicles with pedestrians was highest in 527 (29.5 %) road accidents. Collision between two or more vehicles in 481 (27.0%) and motor vehicle accidents due to loss of control over vehicle in 234 (13.1%) cases was the next commonest mode. Pedal cycle accidents and fall from moving vehicles accounted for 144 (8.1%) and 142 (8.0%) cases. Among mortality cases, the three above mentioned modes contributed for 37.0 % , 21.7 % and 9.2 % respectively.

### **11.13.3 Vehicle responsible and status of person**

Figure 13 reveals the type of vehicle responsible for head injury occurrence.

Figure 13 clearly establishes that two wheeler vehicles were involved in 847 (48.9%) head injuries. Heavy vehicles like Bus, car, jeep and Matadors were responsible for 383 (20.8%) road accidents. Bicycles and Autorickshaws accounted for 184 (10.6 %) and 165 (9.5 %) of cases respectively.

Table 32 reveals the status of person at the time of accident. It can be seen that Pedestrians, motorcycle riders and passengers in motor vehicles constituted 31.0% , 22.1% and 16.7% respectively. Pillion riders of motor vehicles and pedal cyclists accounted for 12.5% and 9.7% of cases respectively.

The mortality was also highest in the above mentioned three categories to the extent of 37.0 % , 31.0% and 12.5 % respectively. The mortality rate specifically among pedestrians, motor cyclists and passenger in a motor vehicle was 14.3 % , 17.2 % and 8.6 % respectively.

Table 32: Status of person

Status	Injured	Killed	Total
Driver of Motor vehicle	64 (3.4)	4 (2.2)	68 (3.9)
Passenger in a motor vehicle	269 (17.1)	23 (12.5)	292 (16.7)
Motorcyclist	331 (21.1)	57 (31.0)	388 (22.1)
Passenger on a motor cycle	205 (13.1)	15 (8.1)	220 (12.6)
Pedal Cyclist	159 (10.1)	11 (6.0)	170 (9.7)
Pedestrian	475 (30.3)	68 (37.0)	543 (31.0)
Stationary Individual	42 (2.7)	2 (1.1)	44 (2.5)
Rider of animal drawn vehicle	21 (1.3)	-	21 (1.2)
status notknown	2 (0.1)	4 (2.2)	6 (0.3)
Total	1568 (100.0)	184 (100.0)	1752 (100.0)

#### 11.13.4 : Factors responsible for road accidents

Information on actual cause of road accident as informed by the victim was available in 1394 (78.1%) instances. These have been classified as vehicle factors, human factors, environmental factors and combined factors. This information is available in table 33 - 35.

FIGURE 13. TYPE OF VEHICLE RESPONSIBLE FOR HEAD INJURY

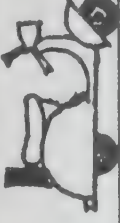

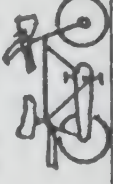




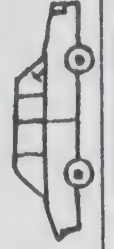
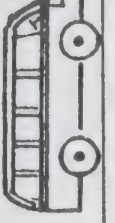



SCOOTER		451	26.0%
MOTOR BIKE		254	14.7%
BICYCLE		184	10.6%
AUTORICKSHOW		164	9.5%
MOPED		142	8.2%
LORRY		130	7.5%
BUS		129	7.4%
CAR		126	7.2%
MATADOR		102	5.9%
JEEP		26	1.5%
BULLOCK CART		21	1.3%
TRAIN		6	0.3%
TOTAL		1736	100%



Table 33: Human errors responsible for road accidents

Factors	No.	%
Sudden road cross without observation	336	33.5
Fall from a moving vehicle	144	14.4
Overtaking while in speed	109	10.8
Over speeding on the road	107	10.6
Sudden turning and skid	96	9.6
Drunken driving	68	6.8
Sudden break application	55	5.5
Entry from wrong side	38	3.8
Sudden vehicle entry in a playsite	23	2.3
Learner and crash	16	1.6
Driver feeling sleepy	6	0.6
Epileptic fits	4	0.4
Total	1002	100.0

Among the human errors contributing for road accidents it can be seen that sudden road cross without observation was responsible for 336 (39.2%) of injuries. Fall from a moving vehicle contributed for 144 (14.4 %) head injuries. Overtaking another vehicle in full speed and overspeeding itself, were responsible for 109 (12.7%) and 107 (12.5%) head injuries. Sudden turning and drunken driving (as informed by subjects) were recorded in 96 ( 11.2%) and 68 (7.9%) cases respectively.

Vehicle problems were comparatively less as mentioned by patients. This was mainly break failure, mechanical problems of vehicles and wheelburst in 23 (44.2), 15 (28.8) and 14 (26.9%) cases respectively.

Environmental problems were the second major reason for head injuries. The causes as mentioned by patients were Predominantly poor quality of roads in terms of presence of ditches, potholes, unevenness, slippery roads, mud roads accounting for 110 (56.7%) injuries. Road humps or speed breakers were responsible for 45 (23.2%) cases. Stray animal entry commonly witnessed on the roads had contributed for 26 (13.4%) cases as shown in table 34.

Table 34 : Environmental problems

Factors	No.	%
Road problems like ditch, pothole, road cutting and others.	98	50.5
Road Humps without indication	45	23.2
Sudden entry of stray animals	26	13.4
Poor lighting	13	6.7
Others like mud roads, uneven roads slippery roads	12	6.2
Total	194	100.0

Apart from the mention of specific factors mentioned above, accidents does occur because of combination of factors which could be a human error, vehicle problem or environmental problem. This is given in table 35.

Vehicle getting upside down due to combined events was responsible for 44 (30.1 %) of head injuries. A combination of events like overspeeding vehicle taking a sudden turn coupled with an environmental problem contributed for 30 (20.5 %) injuries. Narrow congested roads allowing speedy vehicles trying to overtake the passing by vehicle constituted for 30 (20.5%) cases.

Table 35 : Combined factors

combined factors	No.	%
Vehicle upside down	44	30.1
Overspeeding vehicle taking a sudden cross, turn + environmental problem	30	20.5
Overspeeding + overtaking and narrow roads.	30	20.5
Road humps + suddenbreak and skid	21	14.4
Sudden road cross + sudden break + skid	12	8.2
Combined unspecified events	9	6.3
Total	146	100.0

#### 11.13.5 Alcohol and road traffic accidents:

It has been mentioned earlier that 258 (15.8%) individuals aged 16 and above had consumed alcohol prior to the occurrence of injury. Among these, 160 (61.7%) had met with road traffic accidents. The status of persons is given in table 36.

Table - 36 : Status of person and alcohol consumption

Status	Total no.	With alcohol	%
Driver of motor vehicle	68	13	19.1
Passenger of Motor Vehicle	292	12	4.1
Motor cyclist.	388	68	17.5
Passenger in a motor cycle	220	15	6.8
Pedal cyclist	170	15	8.8
Pedestrian	543	33	6.1
Stationary individual	44	2	4.5
Total	1725	158	100.0

It can be seen that alcohol consumption among various persons was high in drivers of motor vehicles ,motorcyclists and pedalcyclists to the extent of 19.1% 17.5 %, and 8.8 % respectively. Even 6.1 % of pedestrians were found to be under the influence of alcohol.

#### 11.13.6 Head injury and protective equipments

It was mentioned earlier that, 388 (22.1%) motor vehicle drivers had sustained head injuries. Among these 388 drivers of two wheeler vehicles, 71 (18.4%) were driving mopeds, 206 were scooter drivers (53.1%) and 111 (28.5%) were driving motorbikes at the time of accident. Among these information on wearing helmets was available in 377 cases (98.2%). It can be seen from table 39 that only 148 (42.0%) were wearing helmets and 229 (52.0%) were not wearing helmets:

Table 37 : Status of helmet wearing in 2 wheeler drivers

status	No.	%
Wearing	148	42.0
Not wearing	229	52.0
Total	377	100.0

It is of interest to note that recently the compulsory usage of helmet has been removed, thereby making helmet wearing optional. The relation between helmet wearing and mortality is shown in table 38.

Table 38 : Helmet wearing and outcome

	Injured	Killed	Total
Helmet wearing	138 (93.2)	10 (6.8)	148 (100.0)
Helmet not wearing	198 (86.5)	31 (13.5)	229 (100.0)
Total	336 (89.1)	41 (10.9)	377 (100.0)

RR= 2.16 : 95 % CI (1.0 - 5.1)

Table 40 shows that mortality among two wheeler riders whether a moped or a scooter or a motorbike is higher when helmets are not worn (13.5%) as compared to wearing of helmets (6.8%) with a relative risk of 2.16 ( CI 1.0 - 5.1) thus signifying that mortality is 2.2 times more among non helmeted persons as compared to helmet wearers. This once again emphasises the protective value of helmets for two wheeler riders.

Helmet wearing was mandatory for drivers of scooters and motorbikes in Bangalore till January 1, 1992 after which through a legislation helmet wearing became optional. Information furnished in table 39 shows important information.

Table 39 : Month wise distribution of injured and killed cases

Month	Helmet +		Helmet -		Total		Final total
	in	ki	in	ki	in	ki	
September	27	3	24	4	51	7	58
October	31	2	24	6	55	8	63
November	33	1	26	3	59	4	63
December	21	2	36	6	57	8	65
Januuary	18	1	42	5	60	6	66
February	8	1	46	7	54	8	62
Total	138	10	198	31	336	41	377

The above table reflects on several important aspects

\* In the city of Bangalore, on an average about 62 individuals meet with head injuries every month among whom about 7 persons succumb to death. This approximately amounts to about 1 in 9 motor vehicle riders meeting with head injuries die during their hospital stay.

\* The mortality among 2 wheeler drivers due to head injuries was 6.8 % and 13.5 % among those with and without helmets.

\* With the removal of compulsory wearing of helmets the frequency of usage declined from 51.7 % in September to 14.5 % by February 1992.

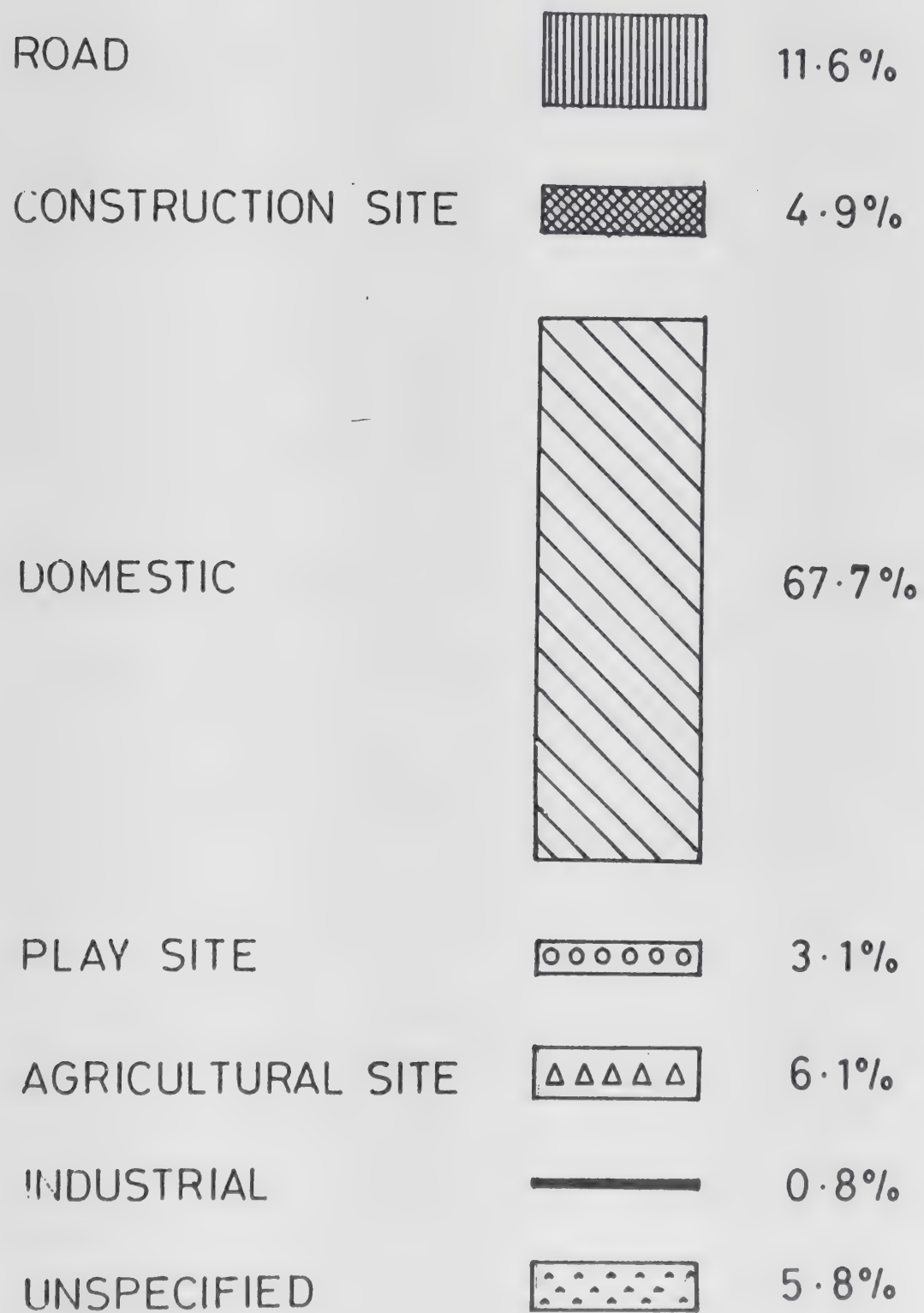
We elicited public opinion on helmets in the exhibition held in connection with the National science day exhibition during March 2 -4,1992 by requesting the visitors to enter their opinion and reasons in a special register. The results showed that among 234 people, 208 (88.9 %) were in favour of using helmets and only 26 (11.1 % ) were against helmets.The various reasons given by them are listed in table 40.

Table 40 : Public opinion on helmet wearing

For helmets		Against helmets	
Helmet to be made compulsory	(66)	Should be optional	(9)
Helmet wearing essential	(63)	Drivers to be cautious	(5)
To decrease head injuries	(21)	Improve road condition	(2)
For life safety	(20)	Uncomfortable	(2)
For safe journey	(5)	Hair loss, Itching	(2)
Must for pillion rider	(5)	Improve standards	(3)
Educate public	(4)	Decreases beauty	(1)
Disguises identity	(2)	Expensive	(1)
To protect against increasing road traffic	(1)	Protects only head	(1)
People must use it on their own	(1)		
Necessary for protection	(1)		
No clear reasons	(18)		
Total	208		26

The information given above indicates clearly that a large majority of people were willing to use helmets .

#### 14. PLACE OF OCCURENCE OF FALLS





### 11.14 HEAD INJURIES DUE TO FALLS

During the study period a total of 653 (22.5%) cases were registered due to falls in several places. The nature of fall has been classified using the ICD -E procedures as shown in table 41.

Table 41 : Mode of fall

Icd E code	Mode	No.	%
E 880	Fall from stairs or steps	106	16.2
E 881	Fall from ladder	23	3.5
E 882	Falls from or out of building ( includes falls from balcony, wall, building, window, electric pole etc.)	155	23.7
E 883	Fall into hole or other opening in surface ( includes fall into pit, drain, hole, tank, well etc.)	23	3.5
E 884	Fall from one level to another (includes fall from chair, bed, tree, st.vehicle, play site etc)	185	28.3
E 885	Fall on same level from slipping, tripping or stumbling.	116	17.8
E 886	Fall on same level due to collision, pushing or shoving	20	3.1
E 887	Unspecified.	25	3.9
Total		653	100.0

It can be observed that fall from one level to another was the most commonest in 185 (28.3%) cases followed by fall from building in 155 ( 23.7%) cases. Fall on same level was responsible for 116 (17.8%) cases, and among these 42 were due to alcohol consumption, 4 due to epilepsy and 15 due to sudden giddiness as reported by patients.

Figure 14 shows the place of occurrence of falls. Domestic falls contributed for 442( 67.7%), followed by falls on the roads in 76 ( 11.6) cases. Falls in agricultural lands and construction sites constituted 6.1% and 4.9% respectively.

Investigation into the height of fall revealed that 136 (20.9%) had fallen from a standing position, while the rest had fallen from different heights. Relation between height of fall and outcome is shown in table 42.

Table - 42 : Relation between height of fall and outcome

Height(in ft.)	Death	Surviving	Total
< 5	9 (6.3)	136 (93.7)	143 (100.0)
5 - 10	7 (5.6)	119 (94.4)	126 (100.0)
10 -15	9 (6.8)	125 (93.2)	134 (100.0)
15 -20	3 (9.4)	29 ( 90.6)	32 (100.0)
> 20	7 (14.6)	41 (85.4)	48 (100.0)
	35 (7.2)	448 (92.8 )	483 (100.00)

It can be seen that mortality increases as the height of fall increases. Mortality among those individuals who had fallen from a height of <10 ft and >10 ft constituted 45.7% and 54.3% respectively.

#### 11.15 : ASSAULT AND HEAD INJURIES

During the study period about 307 (10.6%) were registered as head injury cases due to assault. Assault was commonly noticed to be caused by sharp objects in 106 ( 34.5%) instances and by other means in 173 ( 56.4) cases. Reasons for assault is given in table 43.

Table - 43 : reasons for assault

reasons	No.	%
Alcohol Intoxication	36	12.9
Fights / Quarrels	146	52.4
Family Disputes	57	20.4
Robbery	18	6.5
Communal Violence	22	7.8
Total	279	100.0

It can be seen that fights and quarrels between individuals and subsequent assault with any available object was responsible in 146 (52.4%) cases followed by family disputes in 57(20.4%) cases. Assault due to alcohol intoxication was responsible for 36(12.9%) cases.

#### 11.16 ACCIDENTAL FALL OF OBJECTS

A variety of objects had fallen accidentally on the head causing head injuries in 103 (3.6%) cases. The mode of fall was predominantly " struck accidentally by falling object " in all cases. The nature of objects varied widely. It could be broadly classified as follows.

Table 44 : Nature of objects causing head injuries.

Nature of objects	No.	%
Fall of construction materials like brick, tiles, wall or roof collapse.	33	32.0
Fall of household articles like box, chair, fan, bucket, vessel etc.	21	20.4
Fall of objects at worksite mainly consisting of heavy to medium range objects.	14	13.6
Natural objects like tree branch, tree trunk, wooden logs, rock, stone etc.	16	15.5
Play materials like cricket bat, cricket ball, cycle etc.	8	7.8
Dashing against wall	3	2.9
Unspecified	8	7.8
Total	103	100.0

It can be observed that construction materials, household articles and fall of natural objects had contributed for 33 (32.0%), 21 (20.4%) and 16 (15.5%) cases respectively. Play site objects were responsible for 7.8% of cases among the series.

### 11.17 HEAD INJURIES AND INDUSTRIAL ACCIDENTS

Surprisingly, only 21 (0.7%) cases of head injuries were found to be industrial accidents from the total sample of cases. Among these, accidental fall at worksite constituted 17 (65.4%) cases due to a variety of reasons, predominantly constituted by environmental problems. Four cases were due to hit by a stationary or mobile object.

### 11.18 - STATUS AT INJURY SITE AND AT HOSPITAL ENTRY

Table 45 provides information on the state of consciousness immediately after the occurrence of injury and at the time of reaching hospital.

Level of sensorium	Injury site	Hospital entry
Fully conscious and oriented	488 (16.8)	1964 (67.8)
Drowsy but arousable	164 (5.7)	417 (14.4)
Stuporous	55 (1.9)	-
Unconscious	1983 (68.5)	462 (16.0)
Death	-	12 (0.4)
Not known	207 (7.1)	42 (1.4)
	2897 (100.0)	2897 (100.0)

It can be observed that about 488 (16.8%) persons were fully conscious and oriented and 2202 (76.1%) patients reported loss of consciousness at the injury site. At hospital entry time 462 (16.0%) patients were in a state of unconsciousness and 12 (0.4 %) cases had expired during the interval between injury and reaching a hospital.

The duration of unconsciousness is furnished in table 46. This was calculated since the time of injury occurrence, which, in some cases continued even after admission to the hospital.

Table 46 :Duration of unconsciousness

Duration	No.	%
< 15 minutes	892	40.5
15 Ms.- 30 ms.	453	20.6
30 Ms - 1 hour	274	12.4
1 - 2 hours	176	8.0
2 - 3 Hours	126	5.7
> 3 hours.	281	12.8
Total	2202	100.0

The loss of consciousness was < 15 minutes in 892 (40.5%) cases and a total of 74.5% of cases had duration of unconsciousness varying upto less than 1 hour. Only 281 (12.8%) had a duration of unconsciousness lasting for more than 3 hours.

### 11.19 : CLINICAL ASPECTS

\*\*\*\*\* Haemorrhage immediately after head injury is a common phenomena depicting the possible underlying damage. In the present study, it was observed that haemorrhage from scalp was not noticed in 1327 (45.8%) cases. Bleeding nose was also seen in 728 (25.1%) cases. Bleeding from the ears was recorded in 498 (17.2%) of patients at the time of reaching hospital.

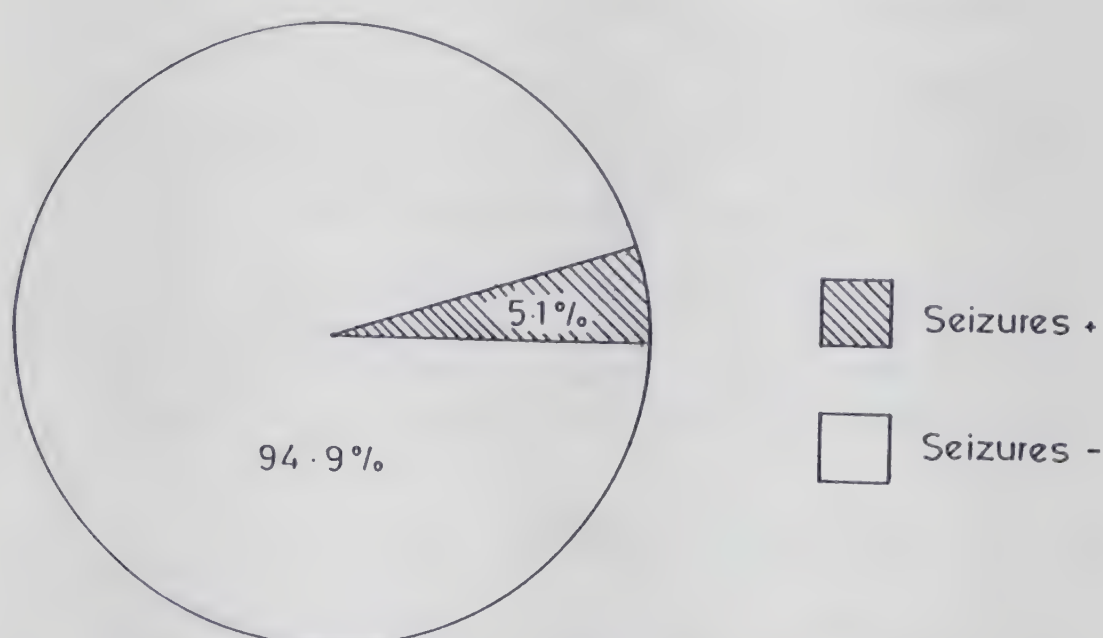
\*\*\*\*\* Eventhough haemorrhage was observed in a large majority of cases, cerebrospinal fluid leak was observed in a very small number of cases. CSF leak from nose, ear and throat was seen in only 22 (0.8%), 28 (1.0%) and 16 (0.6%) cases respectively.

**11.19.1** Observations on the nature of external injuries revealed that about 729 (25.2) did not receive any external injuries. Among the others, 1166 (40.2) had abrasions, 834 (28.8) had lacerations and 168 (5.8) had multiple injuries in different parts of the body.

**1.19.2** Majority of injuries were sustained on the frontal region to the extent of 42.8%. Parietal injuries, Occipital injuries and temporal injuries constituted 21.1%, 19.3% and 15.8% respectively. Injuries in more than one region was identified in 237 (8.2%) cases.

**11.19.3** The occurrence of seizures following head injury at the site of injury underlines the severity as well as the extent of brain damage. It was noticed that 147 (5.1%) patients had a definite attack of seizures as reported by them or by the accompanying members. Among them, 105 (71.4%) had a single attack, 28 (19.0 %) had 2 attacks and the rest i.e. 14 (9.6%) had more than 3 attacks at the site of injury (figure 15).

#### 15. EPILEPSY & HEAD INJURIES



**11.19.4** Associated injuries along with head injuries is a common feature and this is presented in table 49.

Table 49 : Associated injuries with head injuries

Ass. injuries	No.	%
Chest Injury	58	2.1
Abdominal Injury	42	1.5
Pelvic bone injury	50	1.8
Longbone injury	396	14.1

The table shows that about 396 (14.1%) of cases had an associated fracture of long bones of upper or lower limbs.

### 11.19.5 Head injuries and skull fracture

Skull fracture as per the definition is one of the important clinical aspects requiring immediate attention. About 231 (8.0%) had a skull fracture among whom, linear fracture, depressed fracture and compound depressed fracture were seen in 110 (47.6%), 70 (30.3%) and 46 (19.0 %) cases respectively as shown in table 48.

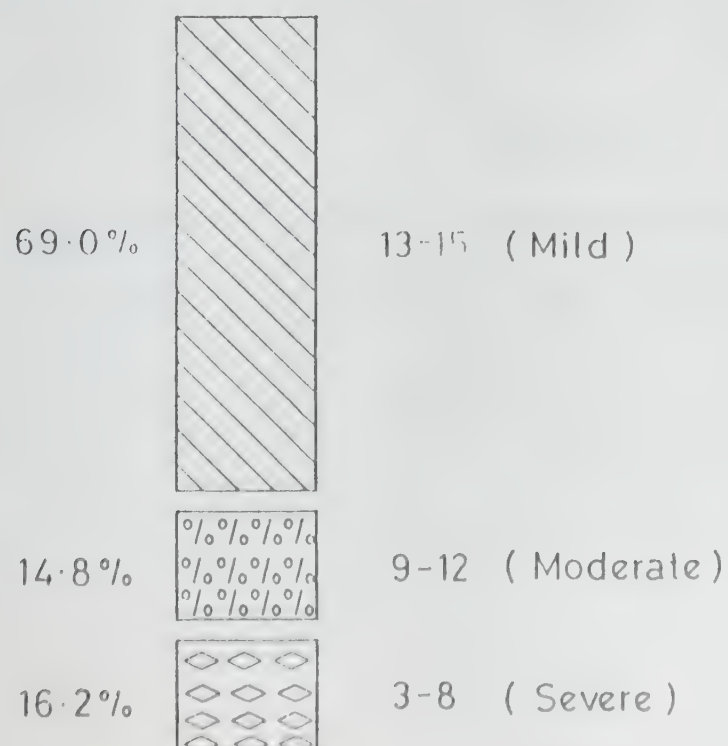
Table 48 : Skull fracture and head injuries

Head injury +	No.	%
Linear fracture	110	47.6
Depressed fracture	70	30.3
Compound depressed fracture	44	19.0
Multiple fractures	7	3.1
Total	231	100.0

### 11.19.6 Severity of head injuries

We adopted the glasgow coma scale, to measure the severity of head injuries. It was noticed that about 445 (16.2 %) had a score of 3 to 8 which could be classified as severe head injuries. About 1890 (69.0 %) were mild head injuries as shown in figure 16.

### 16. SEVERITY OF HEAD INJURY



### 11.19.7 Nature of head injuries

Classification of head injuries is a complex research issue. We adopted the ICD classification procedures initially, but later developed our own method depending on the diagnosis made by the attending physician or consultant. Nature of head injuries as per the availability and classification is given in Table 49.

Table 49 : Nature of head injuries

ICD Code	Diagnosis	No.	%
850	Cerebral concussion	1284	44.3
	Cerebral concussion +linear fracture	49	
	Cerebral concussion +depressed fracture	36	
	Cerebral concussion + compound dep.fracture	29	
	Cerebral concussion +multiple fractures	4	
	Cerebral concussion +seizures	76	6.9
	cerebral concussion + comp.dep.fracture +seizures	4	
	cerebral concussion + dep. fracture + seizures	1	
	cerebral concussion + linear fracture + seizures.	1	
851	cerebral contusion	443	15.3
	cerebral contusion + lf	39	
	cerebral contusion +df	29	
	cerebral contusion+cdf	9	
	cerebral contusion + mfs	2	
	cerebral contusion + seiz- ures.	36	5.3

ICD	Code	Diagnosis	No.	%
		Cerebral contusion + lf + seizures	4	
		Cerebral contusion + Cerebral haemorrhage	37	
		Cerebral contusion + sdh + seizures.	2	
852		Cerebral haemorrhage	65	2.3
		Cerebral haemorrhage +lf	6	
		Cerebral haemorrhage +df	3	
		Cerebral haemorrhage +cdf	2	
		Cerebral haemorrhage +mfs	1	
				0.7
		Cerebral haemorrhage + seizures	4	
		Cerebral haemorrhage + lf + seizures.	2	
854		Head injury unspecified	553	18.9
		Miscellaneous (with combined diagnosis)	85	2.9
		Diagnosis not known	92	3.2

It can be observed that cerebral concussion was the major diagnosis in 1484 (51.2%) cases. Contusion and haemorrhage was seen in 601 (20.8%) and 122 (4.3%) cases. Head injuries with a skull fracture was seen in 231 (8.0%) cases. About 19% of head injuries did not have a specific diagnosis and were classified as unspecified injuries.

## 11.20 MANAGEMENT AND OUTCOME

TABLE - 50 MODE OF MANAGEMENT

Management	NO.	%
Treatment in casualty and sent home	301	10.4
Treatment in casualty and admitted for observation.	102	3.5
Treatment in casualty and referred to other hospitals.	369	12.8
Treatment in casualty and referred to NIMHANS.	1325	45.9
Admission and conservative management	562	19.6
Admission and surgical management.	226	7.8
Total	2885	100.0

Twelve cases who died immediately upon arrival have been deleted from this analysis. It can be seen that major mode was immediate treatment and referral to NIMHANS in 1325 (45.9%) cases. Only (30.9%) patients were admitted in hospitals either for a short duration or for longer periods of stay. About 562 (19.5%) cases were admitted for conservative management and in 226 (7.8%) surgical procedures were undertaken.

The duration of hospital stay of these patients revealed that :

Table 51 :Duration of hospital stay

duration	No.	%
Less than 3 hours	1223	42.4
3 - 6 hours	416	14.4
6 -12 hours	335	11.6
12 - 24 hours	147	5.1
1 - 3 days	265	9.3
3 - 6 days	229	7.9
7 - 14 days	223	7.7
> 15 days	47	1.6
Total	2885	100.0

About 2121 (73.5%) patients required a hospital stay of less than 1 day, with majority of them requiring < 3 hours (42.4%). About 764 (26.5%) required longer duration of hospital stay with about 270 (9.3%) staying for more than 7 days.

Table 52 Outcome at the time of discharge

outcome status	No.	%
Improved	842	29.1
recovered	1803	62.2
Death during hospital stay.	252	8.7
Total	2897	100.0

It can be seen that among the total patients the hospital based case fatality rate was 8.7%., With survival rate of 91.3% at the end of hospital stay. Among the 2645 survivors, 842 (29.1 %) had improved totally during their hospital stay. The out come of remaining patients could not be ascertained as they were in different stages of recovery, at the time of discharge or referral.

### 11.21 FOLLOWUP ASPECTS:

As mentioned earlier under the methodology section, 25 % of patients were contacted after a mean interval of 4.6 months (+/- 2.3 mos ) to examine for their current health status and also to identify sequelae of head injuries. The criterias for selection were:

- i) Patient should have been registered in Phase I of the study at any of the identified hospitals.
- ii) Must have had a definite diagnosis of head injury
- iii) Must have been alive at the time of discharge
- iv) Must be a resident of the city of Bangalore.

Based on these criterias, a list of patients was drawn up. From the final list of 1706 patients, a sample of 425 patients were drawn up (25%) and contacted at their residence with a pretested coded proforma by trained investigators.

All age groups were represented with a higher number of individuals in 20 - 40 years age group to the extent of 194 (45.6%). Children and elderly constituted 93 (21.9%) and 35 (8.3%) respectively. The male to female ratio was 1 : 0.5 . Information was collected primarily from patients and their family members in 403 (95.0%) cases and from the available individual in the house in 22(5.0%) cases respectively.

Among these cases, the cause of head injuries was road accidents, falls, assault, and fall of an object in 63.7 % , 22.4 % , 10.6 % and 3.3 % respectively. Individuals opinion about the quality of care during their contact with the hospitals about care, referral and education revealed that it was adequate in majority of instances. This is given in table 53.

Table 53 : Opinion on quality of care

	Satisfied	Not satisfied	No comments	Total
Care	313 (73.6)	46 (10.8)	66 (15.6)	425 (100.0)
Refer- ral	307 (72.2)	39 (9.2)	79 (18.6)	425 (100.0)
Edu- cation	242 (56.9)	75 (17.6)	107 (25.5)	425 (100.0)

It can be understood that majority of the patients expressed satisfaction over the type of care and referral services provided at the time of hospital stay. However, a large number of them were totally unaware and could not comment anything on these issues. The education provided revealed that only 56.9% were satisfied and 17.6% were unhappy about the same.

The reception given to patients at the time of their contact with all the hospitals revealed that about 241 ( 57.1%) expressed satisfaction in terms of the attitude and behaviour of the attending staff, While 99 ( 23.5%) and 22 ( 5.5% ) felt it was moderate and bad respectively. The remaining 63 ( 14.2%) could not give any definite answer.

#### 11.21.1 CURRENT HEALTH STATUS OF PATIENTS

Table 54 :Current health status

status	No.	%
Fully Recovered	220	51.8
Still Recovering	179	42.1
Death after hospital discharge	26	6.1
Total	425	100.0

It can be seen that 220 (51.8) had totally recovered from head injury effects and 179 (42.1) were still in recovery stages with continuation of treatment at various centres. About 26 (6.1%) had died after discharge from hospital within a period of 60 days due to head injury complications.

Among the 321 individuals who were employed initially before the occurrence of head injuries, about 217 (67.6) had returned to their previous jobs. About 19 (5.9) were continuing on an irregular basis. Nine patients ( 2.8) had changed their jobs after head injuries. About 58 (18.1) patients were not work ing at the time of follow up after a mean interval of 4.6 months. Similarly among children who were attending classes earlier, about 87 (83.6) had returned back to their normal schooling activities. Except 2 ( 1.9%) children , others ( 14.4%) were still irregular due to sequelae from head injuries. The source of income among these cases revealed that since they were continuing with their previous job, this had not changed to a greater extent among those previously employed. Others were dependent on the income of their family members to a greater extent.

Absenteesm due to head injury was noticed in both adults and children. Among adults it was mainly absenting from work and among children it was inability to attend school. The days of absenteesm in both the groups is given in table 55.

Table 55 :Absenteesm due to head injuries

	< 30 days	31 - 60 days	61 -90 days	>91 days	Total
Work	122 (38.0)	53 (16.5)	35 (10.9)	111 (34.6)	321 (100.0)
School	59 (56.7)	14 (13.5)	11 (10.6)	20 (19.2)	104 (100.0)
Total	181 (42.6)	67 (15.8)	46 (10.8)	131 (30.8)	425 (100.0)

It can be seen that among the working class, 122 ( 38.0) had lost work for a period of 30 days , while 111 (34.6) were unproductive for a period of > 3 months. The figures among children for not attending to schools was 59 (56.7) and 20 (19.2) respectively.

#### 11.21.2 HEAD INJURY SEQUELAE

The study attempted to establish the various sequelae of Head Injuries at the time of domicillary contact with patients.

Among the various post head injury problems encountered post traumatic headache, anxiety features and memory problems were present in 109 ( 25.6%), 70 (16.5%) and 60 ( 14.1%) patients respectively. Post traumatic epilepsy was observed in 18(4.2%) individuals.

Table 56 :Sequelae from head injuries (N=425)

	No.	%
Memory problems	60	14.1
Post traumatic epilepsy	18	4.2
Behavioural Problems	54	12.7
Anxiety Features	70	16.5
Headache	109	25.6
Otorrhea	6	1.4
Rhinnorhea	10	2.4
Vertigo	8	1.9
Visual problems	15	3.5
Speech problems	6	1.4
Hearing problems	6	1.4
Locomotor problems	25	5.9

### 11.21.3 COST OF HEAD INJURIES

The expenditure incurred by patients towards meeting expenses for treatment of head injury was available from 367 patients during domicillary contact .This information has been furnished in table 57.

Table 57: cost of head injuries to families

cost in rupees	no.	%	cum.total
< 500	107	29.2	29.2
501-1500	96	26.2	55.4
1501-3000	54	14.7	70.1
3001-4500	25	6.8	76.9
4501-6000	30	8.2	85.1
6001-9000	21	5.7	90.8
9001-12000	12	3.3	94.1
12001-15000	3	0.2	94.3
>15000	21	5.7	100.0
Total	367	100.0	

All these patients and their family members were asked about "what could be done to improve management of head injuries in hospitals ? and " what measures should be adopted for prevention of head injuries ?" based on their individual experiences. This is furnished in table 58.

Table 58: suggestions for prevention and improving quality of care

Towards prevention	Towards improving care
proper driving habits (59)	Improve hospital care (30)
improvement of roads (40)	Improve emergency care (12)
Helmet compulsory (28)	Immediate care for head injury patients (13)
Follow traffic rules (26)	Reduce administrative and legal procedures (11)
Indicate road humps (11)	
Licence regulation (11)	All hospitals and general practitioners must treat head injury patients (9)
Improve road transport system (10)	

----- Towards prevention -----		----- Towards improving care -----	
Avoid alcohol	(9)	Improve ambulance services	(9)
Improve signal system	(9)	Provide educational counselling and after care services	(9)
Improve street lights	(8)	Proper post trauma care services	(7)
Avoid stray animals	(8)		
Strict enforcement	(7)		
Provide education	(7)		
Proper vehicle maintainence	(6)		
follow speed limits	(6)		
Traffic control regulations	(3)		
Avoid footboard travelling	(3)		
Police guidance	(2)		
Oneway traffic measures	(2)		

#### Prevention of head injuries due to falls

proper care of children	(9)
Safer Playgrounds for children	(3)
Avoid slippery surfaces	(3)
Treatment of medical conditions	(2)

Several suggestions have come from head injured patients and family members for improving the quality of services. The most important ones being improvement of hospital care (30 ), improvement of casualty services (12), provision of immediate care for head injury victims (13) and reduction of administrative and legal procedures (11). About 75 patients had several suggestions and 325 did not have any suggestion to offer.

As compared to quality of care ,about 198 (44.5%) individuals had different suggestions for prevention of head injuries. Only 2.0% considered head injuries due to fate. The major suggestions are proper driving habits (59), improvement of roads (40), compulsory usage traffic rules (26) and indicators for the road humps(11) to prevent road accidents. Similarly proper care of children and avoiding violence were suggested for prevention of head injuries due to falls and assault. About 227 patients or their family members did not have any suggestion to place for prevention of head injuries thus signifying the importance of public education.

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Population to double needs 30 years

Road length to double needs 15 years

Accidents and fatalities double in 10 years

Vehicles to double requires only 5 years  
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conducting epidemiological studies on hospital subjects in megacities like Bangalore offer difficulties in terms of data due to multiple care providers and absence of a suitable referral system. Duplications have to be avoided from the beginning to overcome this problem. The geographical definition of cities itself is difficult to comprehend with the rapid outgrowth of cities.

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Case definition,  
Case identification,  
Case ascertainment,  
Classification  
form the corner stones of  
Epidemiological Research  
in Head Injuries

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## 12 : IMPLICATIONS & EMERGING ISSUES

The increasing contribution of injuries and head injuries in both developed and developing countries as a cause of morbidity, disability and mortality along with burdening the strained socio-economic and health care resources is widely recognised as a major public health problem. This situation has received scant attention from politicians, professionals, policy makers, public and the press. Several studies have documented the enormous toll due to injuries in the productive years of human beings thus bringing a premature end to the productivity(28). With increased national and international commitments along with an increase in health budget towards reduction of infectious and communicable diseases, injury related morbidity, mortality and disability will become the major problem of this decade.

The problem of injuries is measured by several ways and prominent among them are morbidity, mortality, disability, PYLL, and cost. The incidence and mortality rates along with it's changing pattern reflect the existing situation. Every country in the world has noticed a significant increase in injuries during the past two to three decades(3). Worldwide, injury ranks fifth among the leading causes of death accounting for 5.2% of total mortality and 10-30% of all hospital admissions (29). In developed countries like USA injuries are the third leading cause of death following cardiovascular diseases and cancer and the first cause upto the age of 44, thereby being the leading cause of premature mortality or years of life lost upto age 65. As per the Indian figures Injuries are the 8th leading cause of mortality. Mortality statistics are however only the tip of Iceberg. Estimates from developed countries reveal that for every fatal injury there will be 45 injuries requiring admission and 1300 emergency room visits. (4)

Information on disability is often much more limited all over the world. It is estimated that 78 million people live because of disabilities from Injuries. About 13% of world's population is disabled and 15% of these result from injury. In a recent survey in India it was found that 6-10% of people with visual handicaps, 8-10% of learning and speech handicapped and 25% with locomotor handicaps were due to injuries (30). While these are shocking figures the hidden fact in terms of PYLL is astonishing and the cost of injuries is still more shocking. As the report from US reveals that the cost of injuries during 1985 amounted to 157.6 billion or \$ 2772 per injured person with direct, morbidity and mortality costs accounting to 29%, 41% and 30% respectively (20).

We observed a hospital based injury incidence of 2340 per month in the city of Bangalore (as per hospital registration rates). This corresponds to about 80 injuries per day and about 29,000 injuries per year. The rates for injuries is definitely an underestimate since only selected hospitals were included even though other hospitals, both government and private, provide care for injury victims. In view of this, the number of injuries could be a minimum 2 times more 1/3 more than the calculated rates amounting to 160 per day OR 4800 per month OR about 57,600 per year. For the whole country it has been estimated that about 3,400,000 deaths occur per year and about 3,400,000 to 6,800,000 seriously disabled or injured per year (10).

About 72% of total cases had occurred in the age group of 25-44 years with the highest incidence in 25-34 years (30.6%). A large body of literature exists today confirming the high incidence of injuries in this age group and age and injuries are directly proportional to one another. Road accidents were the chief causes of injuries in 51.6% of cases followed by assaults and falls in 27.0% and 10.8% of cases. A major type of injuries was those recognised due to burns in 5.1% of cases. These are also the major causes as reported from several other studies (3,13,14,15). Mondays and Tuesdays also recorded a high incidence of injuries with majority of them occurring between 6 PM to 12 midnight. Public transport was the major means of transport with only 16 % using ambulance services.

Research on epidemiology of head injuries poses considerable methodological problems. Problems in case definition, classification, procedures of data collection, bias in information gathering present large scale difficulties. Also situations in developing countries are of a different nature as compared to developed countries in terms of information collection, processing, applicability and utilisation. Collecting information from head injury victims poses problems in unconscious state of patients brought to hospital specially at night times by an unknown person without much information on the victim. This problem would be difficult to overcome in many situations all over the world. Combination of different methods must be adopted for epidemiological studies on head injuries.

Conducting epidemiological studies on hospital subjects in megacities like Bangalore offer difficulties in terms of data due to multiple care providers and absence of a suitable referral system. Duplications have to be avoided from the beginning to overcome this problem. The geographical definition of cities itself is difficult to comprehend with the rapid outgrowth of cities.

For eg.: The city of Bangalore can be classified as Bangalore (BDA limits), Bangalore city ( Corporation limits ) and Bangalore urban agglomeration ( including notified areas and outgrowths). We used the last definition for our denominator as population from a large area use services from any of these hospitals for head injuries.

Hospital based epidemiological studies despite their limitation can be a good source of information in the area of head injuries. It is unlikely that cases registered in other places are not referred to tertiary institutions. Also, hospital records can be developed properly if sufficient attention is paid at the beginning of study. Hospital data can provide considerable insight into the problem of head injuries which could be supplemented by population based studies. Population based studies offer advantages to study multifaceted aspects of head injuries in terms of risk, exposure, behaviour and the epidemiological triad of head injuries

Head Injuries occupy a special place in injuries due to damage inflicted on central nervous system and because of serious disabling effects even after the acute effect is over. Head Injuries usually account for more than 25% of all accident injuries. Head Injuries in three surveys at Manchester (USA), Gote borg (Sweden) and Lensmontmedy(France) constituted 4.7%, 6.8% and 13% of cases respectively (29). In the United States head injury account for 12% of all Injury hospitalisations(19). Generally, it is accepted that 30-50% of Injuries have head Injuries in isolation or in combination. Head injuries constituted 20.6% of total cases in our study. We noticed from this first incidence study, a specific head injury incidence rate of 60/1,00,000 for the six months period.Considering that about 25 % of cases are managed in private hospitals which have not been included and also a few head injuries are managed in other hospitals or nonreporting the " incidence rate will be 75/ 100,000 for the six month period". With the assumption that the situation is not influenced by any positive or negative factors and all other factors remaining same , the incidence will be 150/100,000 per year in the city of Bangalore. This corresponds to about 20 head injuries per day OR 600 per month OR 7200 per year.This incidence rate is definitely on the lower side as it does not consider cases dying at the site of injury or during transportation or deaths after hospital discharge . In totality the incidence of head injuries is likely to be about 200/100,000/year in the city of Bangalore.

The findings from studies done in developed countries is presented in table 59.

Table 59: Incidence and Mortality rates from Head Injuries from selected studies

author	place of study	year of study	incidence rate per 1,00,000 population	mortality rate per 1,00,000 population
Jess F. Kraus et al(31)	San Diego County USA	1982	180	30
Annegers et al(32)	Ohmsted county USA	1965- 1974	193	20
Klauber et al(33)	San Deigo california	1978	295	22
Jagger et al(34)	Charlottesville USA	1978	208	14
Cooper et al(35)	Bronx county, NY	1980-81	249	28
Jenett et al (36)	England, wales Scotland	1981	270	-
Edna et al(37)	Norway	1986	200	-
Fife et al (38)	Rhode Iceland USA	1986	152	-
Nestold et al(39).	Norway	1988	236	-
Laurence Tiret et al.(40)	Aquitane France	1986	281	22
PRESENT STUDY	Bangalore, India	1991-92	150	

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About 25,000 vehicles are added onto  
the city roads every month. Every day  
about 160 vehicles are included, out of  
which 130 are two wheeler vehicles  
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On an average , about 20 head injuries occur everyday.  
Among these about 2 cases have a fatal outcome. This  
corresponds to about  
600 head injuries and 60 deaths per month

OR

7,200 head injuries and 720 deaths per year  
in the city of Bangalore  
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Road traffic accidents contributes for  
60 - 65 % of Morbidity and Mortality  
from Head Injuries.  
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The risk of mortality increases by  
more than two times with the  
consumption of alcohol

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**Table 60 : Cause of head injuries**

Author	Place	Year	Traffic	Falls	Firearms	Assault
Nestold et al(39)	Norway	1988	57.6	-	-	-
Tiret et al(40)	France	1990	59.6	32.5	0.9	-
Annegers JF et al(32)	USA	1980	47	29	3	4
Klauber M.R.et al(33)	USA	1981	53	30	-	11
Kraus JF et al(31)	USA	1984	48	21	6	12
Cooper KD etal(35)	USA	1983	31	29	: 33	:
Jagger J et al(34)	USA	1984	55	20	: 11	:
Rao(41)	Hyderabad	1967	30.0	48.2	-	14.0
Jain	Delhi	1969	34.7	48.5	-	1.8
Sambasivan	Trivandrum	1975	38.0	32.0	-	18.0
Kalayanaraman	Madras	1975	45.0	35.0	-	11.0
Devadiga	Manipal		54.7	32.0	-	4.7
Natarajan (14)	Madurai	1987	44.1	16.9	-	29.5
Dhingra (42)	Aligarh	1988	35.0	31.0	-	-
present study.	Bangalore	1991 1992	61.6	22.5	-	10.6

Head injuries are caused predominantly by motor vehicle accidents to the extent of 40 to 60 % in different countries. Domestic falls, fall or hit by an object, violence, industrial accidents are other causes leading onto head injuries. Head injuries also occur at different places like roads, home, worksite, school, recreation sites and others. Table 60 shows causes of head injuries in different studies.

All the earlier reports have confirmed the higher incidence of head injuries in younger age groups and among males. In the present study, the highest incidence was noticed in the age group of 25-34 years to the extent of 23.2% followed by 15-24 years in the order of 20.9% thus totalling to 44.1%. The incidence among males and females was 206 and 70 per 1,00,000 population per year respectively. The high incidence among males and in the age group of 15-34 years necessitates efforts to prevent head injuries.

The educational status of patients revealed that about 42.5% had attained educational level of more than high school standards. Those who were unable to read and write constituted 19.4%. The occupational status revealed that all categories of workers had sustained head injuries. Students constituted the highest number to the extent of 18.6%. Next in priority was production process workers in 15.0% of cases. This group consists of workers engaged in different sectors like textile, leather industry, printing and other industries. Professionals and related administrative sector workers constituted 6.8%. The family income per month of the patients revealed that 44.8% were in middle income group (501-1500 per month). Majority of them were from small and medium families. About 43.0% had dependents by being married. These factors play a predominant role in awareness, help seeking, utilisation and also rehabilitation for head injuries as it should be suited to their current status.

All over the globe it has been clearly established that alcohol is one of the major risk factors for head injuries (2,3,20,43). It is known that alcohol impairs the level of thinking and decision making at a particular time and is also associated with severity and consequences from head injury. Alcohol has been found to be the direct cause of 30-50% severe road accidents and fatalities. In the present study we noticed that 32.0% of individuals above 15 years were habitually related to alcohol consumption and 15.5% (50%) of head injuries were attributable to alcohol directly. About 72% of these individuals had consumed alcohol within 3 hours of injury occurrence. About 15% road accidents, 19.6% falls, 17.2% of assaults were directly attributable to alcohol in our study. The role of alcohol and its relation to status of victim revealed that 17.5% of

motorcycle riders and 19.1% of motor vehicle drivers had consumed alcohol and met with head injuries subsequently. Pedal cyclists and pedestrians constituted 8.8% and 6.1% within this group. We noticed all categories of alcohol consumed individuals including pedestrians meeting with head injuries. Only Combined strategies aimed at individual, family and community along with clear terms of licencing and legislation would reduce head injuries. Simple means of detecting alcohol in all places should be put into practice. We did not have any cases as a consequence of consuming psychotroptic substances, while, several reports have confirmed this association and future research should be promoted in this area.

Among the several associated conditions associated with head injuries. We noticed visual problems, hearing problems, hypertension and epilepsy to be the chief ones in 3.8%, 3.2%, 3.0% and 2.8% respectively. It has to be realised that these problems could lead onto and also be caused by head injuries. It could also be seen that majority of these patients, even though being aware were not under any treatment. The association between these conditions and head injuries require further studies.

Among the causes, road traffic accidents contributed to 61.6% of cases. This was followed by falls in 22.5%. Assault due to interpersonal conflicts were documented in 10.6% of cases. Fall of object due to variety of reasons through different objects were seen in 3.6% of cases. Our findings show a higher occurrence of road traffic accidents. The situation analysis reveals the reasons for this factor. The increasing number of vehicles with a phenomenal rise in two wheeler vehicles without strengthening of corresponding areas like road availability, road safety, road user behaviour, comprehensive trauma care facilities and improved public transport system. The obvious result has been an increase of injuries from 4000 in 1985 to 6500 in 1991 with a corresponding increase in head injuries.

With road accidents classified to roads, place of occurrence or other type of head injuries revealed that next to roads, Domestic accidents due to fall, Assault and FOB were recorded in 67.9%, 45.90% and 49.5% of cases respectively. Fall of objects in construction places was seen in 7.8% of cases. Fall or hit by an object was also seen in 9.7% of cases. This information is important as any measures directed towards prevention has to focus on safety precautions about place of occurrence by making it safe for individuals.

Working in close collaboration with related sectors like police, transport, industries etc. offer considerable advantages. Apart from examining the uses of pooling data, certain information not available in hospitals can be collected. Specifically this could be in situations of fatal injuries not reaching a health care agency. Caution has to be exercised in interpreting this data as it

depends on knowledge, skills, site verification, person reporting, tabulation and classification procedures. Mortality can occur on the spot, during hospital stay or after discharge. But, the limitation of this source is its non completion nature as all fatal and nonfatal injuries are not registered with them.

The interval between injury and first medical contact is often the deciding factor for survival and disabilities. The 'Golden hour' is very precious in saving the life of injured person. About 90% of patients irrespective of cause had contacted a medical agency where they had received emergency services, while only around 50% had reached a speciality institution where specific trauma care services available within one hour. Eventhough contact with an agency was made, head injuries are referred due to lack of supportive facilities in peripheral hospitals. Another reason for the delay is the dependency on transport services to reach a speciality hospital for head injuries. As evident only 14.9% had arrived through an ambulance and 65.4% had to depend on other means of transport. Strengthening facilities at peripheral hospitals along with an effective referral system is important.

Availability of first aid services for accident victims is one of the important components in provision of emergency medical services. We noticed that only 12.3% of patients had received some type of first aid services eventhough it was not possible to determine the type and quality of care. A local nearby general practitioner was the main source of care in 83.1% of cases irrespective of the cause, followed by public and family members in 13.0% of cases. This emphasizes the importance of educating public on simple first aid measures for injury victims.

The source of referral for head injury cases revealed that about 21.0% of cases had reached a definitive hospital on their own directly. The high referral from other centers could probably be due to nonavailability of speciality services along with the practice of non admission of injury victims due to fear over subsequent legal complications. Eventhough recent legislation emphasize the need for treatment at any centre, the previous experience of legal complications and entanglement might direct them from providing long term care and services.

Expenditure incurred by head injury patients is one of the crucial elements in deciding the option choosen by people. It was observed that about 80% of patients had spent < Rs. 300 ( US \$ 10) till they reached a hospital. The number of patients spending more than Rs. 900 ( US \$ 30) was 6.4 % . There was not much of variation across different causes. This costing essentially includes cost towards first aid care and transportation. The low cost incurred

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The risk of mortality is increased by  
more than two times  
for  
two wheeler drivers  
without Helmets

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could possibly be due to the large number of patients residing within the city where the number of help seeking contacts were less than 2 or 3. Section of patients coming from distant and remote places will definitely incur large sums of money along with considerable difficulties in obtaining care and transport facilities.

During the study period the place of road traffic accidents was an interesting aspect of study. Information on this would enable policy makers and programme managers to direct resources for traffic safety purposes. During the period highway accidents and non highway accidents contributed for 20.2% and 64.9% respectively. All roads within the city joining the main highways were included under the former category as the nature of traffic density and flow are different from the latter category. Among the 10 highways originating or passing through the city, Bangalore-Mysore Road accounted for the highest number of accidents to the extent of 24.4%.with Bangalore - Bellary and Bangalore - Tumkur highways contributing for 19.4% and 13.9% of accidents. The increasing traffic on these roads coupled with bad road conditions and non adherence to traffic norms has also been highlighted in the press several times. Within the city almost all areas had recorded head injuries. We attempted to identify 10 major areas of highest injury occurrence in the city to be considered as "accident spots" for further research to identify black spots in these areas towards immediate action.

The three major modes of road traffic accidents were MVA involving collision with a pedestrian (29.5%), MVA involving collision with another motor vehicle ( 27.0%) and MVA due to loss of control (13.1%). Fall from a moving vehicle and pedal cycle accidents contributed for 8.0% and 8.1% of cases respectively. This information is of enormous value in understanding mode of injuries in a given place and also for comparison across cities or countries. It also helps in focussing efforts to head injury control and prevention by concentrating on specific categories of road users.

Undoubtedly, injuries and head injuries are no more considered as " fate or unknown ". A clear mechanism and process underlies the event constituting epidemiological triad through agent, host and environmental factors even though a combination of these operate at many times. Among the human factors, sudden crossing of the road without observation, overtaking another vehicle in speed, overspeed in itself were the three major reasons in 39.2%, 12.7% and 12.5% respectively. Among the environmental mainly road problems like presence of uneven roads due to ditch, pothole, road cutting were responsible for 50.5% of accidents. The recent introduction of road humps or speed breakers in the city contributed for 23.2% of road problems, emphasizing the importance of indicators on both sides of road humps and need for change in the design. Chief among the vehicular factors were brake failure, mechanical problems of vehicle

and wheelburst in 44.2%, 28.8% and 26.9% respectively. Sudden toppling of vehicle was the main reason under combined factors in 15.2% head injury cases.

Type of vehicle involved in road traffic accidents revealed that two wheeler vehicles were responsible for 48.9% of accidents. Heavy vehicles were incriminated in 20.8% of cases. The driver of a motorcycle ( including scooter and moped ) was the victim of head injuries in 22.1% of cases. Passenger in a motor vehicle was injured in 16.7% of cases. Pedestrian had sustained head injuries in 31.0% of total cases.

Vast experience all over the globe has emphasized the need for protective equipments and devices in reducing severity and mortality in road traffic accidents(44,45,46). While in India only helmets or head gears have been in practice for two wheeler drivers. Majority of the states do not mandatorily stipulate the wearing of helmets in India except the central union territory of New Delhi. In Karnataka, the law was in enforcement till 1.1.1992 which was removed thereafter for reasons unknown. We observed an increase in mortality by 2 times among nonhelmeted riders. Education of the public along with proper enforcement measures are essential in every city. At the same time increased research about the design and quality of helmets are required to make it more acceptable to the public. We did not attempt to study the role of seat belts etc. as they are not in vogue in India.

Eventhough a large majority of head injuries are due to road traffic accidents, substantial number of them occur due to other causes like falls, fall of an object, industrial accidents and others. since the purpose of the study was to comprehensively examine the problem of head injuries, we noticed that 22.5% of falls had resulted in head injuries. Majority of these falls( 67.7%) had occurred in domestic or residential buildings and about 11.6% on the roads due to causes other than MVAS. About 43.5% of these falls had recorded a height of fall being more than 10 feet. The height of fall was directly related to outcome as evidenced by the increase in deaths. Investigation into the mode of fall revealed that about 28.3% had occurred due to fall from one level to another, 23.7% due to falls from or out of building and 17.8% due to fall from stairs or steps. This information will be vital in engineering, safety and educational measures to be developed for injury prevention .

Assaults under the influence of alcohol was recorded in 12.9% of cases while fights and quarrels were noticed in 52.4% of

cases. Head injuries due to unintentional fall of construction materials like brick, tile, wall or roof was noticed in 32.0% of cases with fall of household articles in 20.4% of cases. Industrial accidents leading onto head injuries was seen in only 0.7% of our cases. The probable reason for this could be the non referral of cases as some institutions have facilities for visiting specialists. Another reason could be while other injuries are more, head injuries could be of a lesser magnitude. We feel that separate studies are required to investigate this observation in greater detail.

One of the criterias for our case definition of head injuries was brief or prolonged loss of unconsciousness after the injury. Collecting information on this presents difficulties as it has to be collected from either the patient or the accompanying member who has witnessed the changes in the injured person. Among those who had lost consciousness, majority of them(74.5%) had reported that the duration of unconsciousness varied from 5 minutes to 60 minutes. Only 26.5% had lost consciousness for more than 1 hour. Loss of unconsciousness along with duration indirectly and directly decides the survival and management procedures. Education and training on managing unconscious patients due to injury should form part of organising emergency services in all places.

About 5.1 % patients had an attack of epileptic seizure with 29 % having more than one attack. Associated injuries with head injuries are an important aspect of head injury management. Associated external injuries were present in 74.8% of cases varying from abrasions to multiple superficial and deep injuries. An associated skull fracture was present in 8.0 % of cases. Associated long bone fractures were noticed in 14.1% of cases. The management of head injury patients is often determined by these associated conditions paving the way for referral of patients along with availability of facilities. Findings from our study stress the need for comprehensive trauma care services as it would restrict referral to a minimum extent.

Measuring severity of injuries is a complex problem. We adopted the glasgow coma scale for concluding severity of patients at the time of hospital contact. About 16.2% of head injuries were severe with a score of less than 8 in our series. Moderate head injuries was recorded in 14.8% of cases.

Eventhough we used ICD procedures for deciding nature and type of head injuries, some situations present difficulties. With multiple injuries and combined diagnosis problems will be experienced in classification and coding. We decided to overcome this problem through a separate method during data entry itself and classifying others as associated injuries present along with head injuries. The nature of head injuries revealed that cerebral concussion, contusion and haemorrhage were recorded in 55.8%,

20.8% and 4.3 % of cases respectively. Head Injury unspecified was documented in a large majority of cases which were included as they fulfilled the criterias of our case definition. This signifies the importance of developing suitable classificatory and coding procedures specially in developing countries due to lack of advanced investigative facilities.

Information on management and outcome among head injury victims reflect the need for strengthening services along with focussing measures towards prevention of head injuries. We noticed that a large majority of patients, 72.6% were given the requisite treatment and sent home or referred to other hospitals. About 42.4% of these patients were in the hospital for only a period of less than 3 hours. The mean duration of hospital stay for these patients was 4.7 (+/- 5.0 hours) among referred cases. Among those who were hospitalised for more than 24 hours, the mean duration of stay was 7.8(+/- 9.5 days), with 9.3% being admitted for more than one week. The above findings clearly suggest the increased referral of patients in the city. The possible reasons for this are shortage of facilities like bed, manpower and other facilities along with non availability of comprehensive trauma care services.

The outcome at the end of hospital stay revealed that 29.1% of cases had totally improved. About 62.2% of cases were either discharged or referred but still had deficits at the time of discharge. The case fatality rate in the series was 8.7% with 252 dying due to head injuries during hospital stay. About 26 persons had died after discharge from hospital which was identified during domiciliary contact. Thus, the total mortality rate in the present series was 9.7 %.

Head injury sequelae is an important area of research and several studies have confirmed earlier about residual deficits depending upon severity and outcome (15,17,47). Head injuries are associated with a variety of neuropsychological and cognitive deficits. The short term or long term disabilities often interface in the normal functioning of the individual. We selected a group of 425 (25%) of patients chosen on specific criterias to examine sequelae of head injuries after a mean interval of 4.6 months.

About 51.8 % reported that they had totally improved, 42.1 % were still recovering and under treatment. About 45.6% of adult productive patients had lost work for more than 60 days and a small number of 18.1% were still not working at the time of contact. Similarly among children about 56.7% could not attend school for a period of 30 days and 19.2% for a period of more than 90 days. This emphasises the need for supportive training and employment opportunities.

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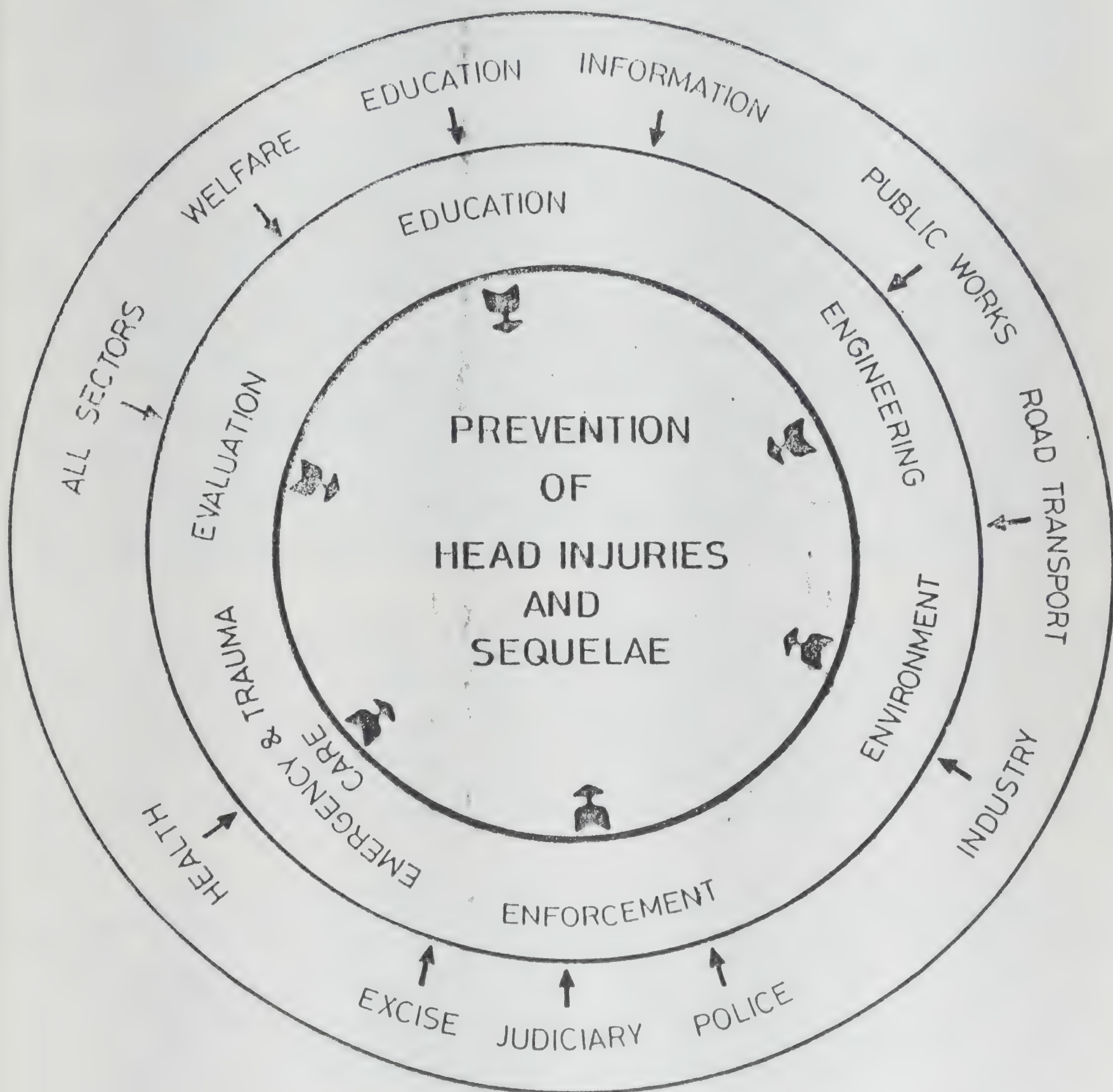
The case fatality rate in our study  
was 9.6 % among the hospital  
registered cases

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Today, it is increasingly realised  
that Head injuries are responsible  
for suffering , greif , pain , and  
anxiety to the human beings. Also  
the increased expenditure on health  
care costs along with loss of human  
lives is phenomenal to every country.

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Among the various deficits identified, post traumatic headache, anxiety features and memory problems were the predominant ones in 25.6 %, 16.5 % and 14.1% respectively. Post traumatic epilepsy was encountered by 4.2% of subjects for which they were receiving treatment. This finding is based on symptom grouping along with confirmation by medical records. While these are the short term sequelae, further research in this area is warranted. Longitudinal studies to know the long term consequences of head injuries should be undertaken to assess the need for supportive and rehabilitative services.

Expenditure incurred by patients was examined in 356 patients from whom information was available. This includes various costs for transport, treatment, follow up care and other aspects. About 70.1% of patients had incurred an expenditure of upto Rs. 3000/- (US \$ 100). About 15.0%, 5.7%, 3.3% and 6.5%, had incurred costs of Rs. 3000 - 6000, 6001-9000, 9001-12,000 and >Rs.12,000 respectively. It has to be remembered that this pure cost analysis does not take into account the loss to individual due to his earnings, loss of family members income due to absenteeism and loss to the employer and amount spent by health care agencies provided by government. Also a major part of expenditure is borne by government hospitals for care and management of head injury patients which has not been included. Costing of head injuries will be extremely useful to know the burden on society which should include direct and indirect costs. This should include medical cost, amount spent by individual and his family, loss of work, loss of productivity, expenditure on damaged property and other areas like years of premature loss of life.

Thus, the present study has examined the problem of head injuries in a mega city like Bangalore in its various facets. The emerging picture in this city is likely to be similar to other cities in India and other developing countries with minor variations. Considering the impact of head injuries on individuals, families and communities, it is obvious that efforts towards services, prevention and control and rehabilitation need immediate attention of policy makers, politicians, professionals, press and public.

Since the problem of head injuries is multisectoral in nature a combined, integrated, coordinated planning and implementation would greatly help in developing appropriate and relevant programmes. Trauma care services, education, engineering, enforcement and evaluation would form the pillars on which head injury prevention and control activities should evolve. Periodical evaluation of programmes and interventions would be a basic prerequisite for appropriate modifications and resource allocations (figure 17).

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PREVENTION & CONTROL  
of  
HEAD INJURIES & INJURIES

must be an integrated, coordinated,  
multidisciplinary activity in Health  
Care delivery system.

The use of appropriate technology and  
community participation constitute  
the mode and focus of activities. The  
realities and challenges require

Political committment,  
Professional involvement  
People's participation,  
Policy makers cooperation, and  
Press contribution

for developing

Emergency and trauma care,  
Educational  
Engineering,  
Enforcement and  
Evaluation strategies .

HEAD INJURY PREVENTION & CONTROL  
CARE &  
REHABILITATION

must form essential components of  
national and international agenda  
in the forthcoming years.

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**13 : SUMMARY FINDINGS**  
**of the project**  
**"EPIDEMIOLOGY OF HEAD INJURIES IN BANGALORE"**  
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The rapid progress towards urbanisation, industrialisation and modernisation have brought together a gamut of problems causing unprecedented proportions of human misery, grief and suffering. Among these, injuries and specially head injuries place a considerable amount of burden on the individual, family and society at large by draining precious human resources. Information on the problem of head injuries has been very limited from any of the Indian cities, with the available statistics representing only the tip of the iceberg. To enable policymakers and programme managers to develop appropriate programmes towards CARE, PREVENTION and REHABILITATION, the present study was undertaken in the city of Bangalore during the period August 1991 and June 1992.

During the study period information was collected from 2897 head injured patients registered in seven hospitals within the city. Trained investigators collected data through direct interviews from patients or their accompanying members with the help of a pretested and precoded proforma. Brief information was also collected from 14036 injury patients for the same period. The results of the study indicate the alarming situation emerging in the city. At the same time attempts towards prevention and control has received low priority. The study results given below indicate the serious nature of the problem in its various facets.

**INJURIES:**  
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1. The number of injuries has been steadily increasing over a period of time. During the period 1985 to 1991 the number of injuries increased from 3800 to 5600 per year. The first six months of 1992 have registered a total of 3200 cases as per official reports.

2. About 500 to 600 individuals are killed in road traffic accidents alone every year.

3. The number of vehicles has increased considerably over a period of time and as on July 1992, about 7,00,000 vehicles use the existing roads in the city apart from vehicles entering the city from outside places.

4. During the period sept. 1991 and feb. 1992 a total of 14036 injuries were registered in the study centres, thus averaging to about 160 injuries per day or 4800 per month or 57,600 per year. As compared to any other disease injuries are a major public health problem.

5. Highest number of injuries occurred in the age group of 25-34 years (30.6%) followed by 15-24 years (23.7%) . The age groups 15-44 years constituted 71.8 % of total cases. Male to female ratio was 1 : 0.2.

6. Cause of injury revealed that road traffic accidents (51.6%), assaults (27%), falls (10.8%), burns (5.1%) and others (5.5%) were the major categories.

7. Mondays recorded highest number of injuries to the extent of 17.2% with a gradual decline towards the end of the week.

8. Highest injuries occurred between 12 noon to 6pm (32.9%) followed by 6 pm to 12 midnight (29%).

#### HEAD INJURIES

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9. Head injuries constituted 20.6 % of the total cases.

10. On an average , about 485 head injuries are registered every month in various hospitals of the city or about 16 cases per day with NIMHANS registering 71.2% of the total cases.

11. The incidence of head injuries in the city of Bangalore was 60/100,000/ for six months period as per the study results. With the consideration that about 25 % of the cases might have been underreported, the incidence estimate would be 150/100,000 per year.

12. Head injuries were found to occur in all age groups with the highest incidence in the 20-29 years age group to the extent of 26.5%. Children , adolescents, middle aged and elderly constituted 20.8 %, 20.9 %, 51.0 % and 7.3 % respectively. The male to female ratio was 1 : 0.3.

13. About 23.1 % of the injured patients were educated beyond high school levels ( more than 10 th standard ) and 19.4 % were illiterates.

14. The occupational status of patients revealed that 18.6 % were students , 10 % were housewives and 43.5 % were engaged in various productive jobs. The highly skilled and professional people constituted 6.8 % of total cases.

15. The family income of our case series revealed that about 40.5 % belonged to families with a total income of less than Rs. 1000 per month. Only 9.4 % of the cases were from families with an income of more than Rs. 3000 per month.

16. About 43.0 % of the individuals were married and 27.7 % were unmarried at the time of injury occurrence.

17. More number of head injuries had occurred on Mondays, Thursdays and Sundays to the extent of 16.0 % and 14.6 % and 14.5 % respectively.

18. As noticed earlier the bulk of head injuries occurred between 12 noon to 12 midnight (68.4 %) with head injuries between 12 noon to 6 pm constituting 35.7 % of total cases.

19. The commonly associated medical conditions were visual problems(3.8 %), hearing problems(3.2%),Hypertension (3.0 %) and Epilepsy (2.8 %).

20. Alcohol was found to be a major risk factor for head injuries in the study.About 16.5 % of head injuries were directly attributable to alcohol consumption in individuals aged 15 years and above, with 75 % of them consuming alcohol within the past 3 hours of head injury occurrence.

21. The risk of mortality increased by 1.8 times among those who had consumed alcohol as compared to nonalcoholic persons.

22. The proportion of road accidents,falls and assault among those who had consumed alcohol accounted for 14.8 %, 19.6 % and 17.2 % respectively.

23. Road traffic accidents(61.6%),falls in various places (22.5%), assault(10.6%) and fall of objects( 3.6 %) were the major causes of head injuries.

24. The major cause of mortality due to head injuries was road traffic accidents in 68.8 % of cases. Falls, assaults and fall of objects constituted 22.6 %, 5.4 % and 3.1 % respectively.

25. Only 15 % of the patients had used ambulance services to reach a hospital ,while ,the major mode of transportation in 65.4% of cases was public transportation.This finding did not vary much according to different causes.

26. While all the road accidents had occurred on the roads,falls were commonly occurring at place of residence (67.9%), on the roads (11.6 %) and agricultural lands (6.1%). Assaults were common on in similar places to the extent of 45.9 %,27.4 % & 6.5 % respectively.Fall of objects at residence and playsites were commonly noticed.

27. The interval between injury and first medical contact varied widely with 86.5 % receiving medical help within one hour of injury occurrence.

28. An interval of < 1 hour had elapsed in 24.1 % of injuries while they were brought to a multidisciplinary hospital. The number of patients reaching a major hospital in 1-<3 hours, 3-<6 hours and >6 hours constituted 30.5 %, 19.0 % and 26.5% respectively.

29. Only 13.3 % of head injuries were provided first aid services at the accident spot and the major source was a medical practitioner in 83.1 % of cases.

30. About 21.0 % of head injury victims had reached a definitive hospital directly, while 49.2 % were referred from nearby and distant hospitals.

31. Information on expenditure incurred by patients till they reached a major hospital revealed that about 95 % had spent an amount of Rs.1500 .

32.1. The geographical location of road traffic accidents revealed that about 20.2 % were highway accidents and 64.9 % had occurred within the city limits.

32.2. Among highways, Bangalore - Mysore road , Bangalore - Bellary road and Bangalore - Tumkur road were the highest accident sites contributing for 24.4 %, 19.4 % and 13.9 % of accidents respectively.

32.3. Within the city , Sampangiramnagar, Subashnagar and Rajajinagar were the highest accident sites.

32.4. Motor vehicle collision with a pedestrian was the commonest mode of injury (29.5 % ), followed by collision between two or more than two vehicles (27.0 %). Motor vehicle collision due to loss of control over vehicle and pedal cycle accidents accounted for 13.1 % and 8.1 % respectively.

32.5. Specific examination between mortality and mode of road accidents revealed similar pattern as mentioned above was noticed in 40.0 %, 21.7 % and 9.5 % of deaths.

32.6. Two wheelers had caused highest number of head injuries (47.9%) followed by heavy vehicles (14.9%), Bicycles (10.6 %) and autorickshaws (9.5 %).

32.7. Pedestrian, motorcyclist and passenger in a motor vehicle were the status of persons at the time of head injury in 30.3%, 21.1 % and 17.1 % respectively.

32.8. Among those head injuries resulting in death, Pedestrians, motor cyclists and passenger in a motor vehicle were the principle groups in 37.0 %, 31.0 % and 12.5 % of deaths.

32.9. The major human factors responsible for road accidents were sudden road crossing without observation (33.5%), fall from a moving vehicle (14.4%), overtaking a passing vehicle in high speed (10.8%) and overspeeding on the road (10.6%).

32.10. Predominant vehicle problems were break failure (44.2%), mechanical problems of the vehicle (28.8%) and wheel associated defects (26.9%)

32.11. Presence of road problems, road humps without indicators and sudden entry of stray animals were the main environmental errors in 50.5%, 23.2% and 13.4% respectively.

32.12. About 17.5% % of motorcyclists and 6.1 % of pedestrians were found to be under the influence of alcohol at the time of accident. The corresponding figures for motor vehicle drivers and pedal cyclists was 19.1 % and 8.8 % respectively.

32.13. The mortality among two wheeler drivers without helmets was 2.2 times higher as compared to those those with helmets (OR 2.16).

32.14. On an average ,in the city of Bangalore about 60 - 65 two wheeler riders meet with head injuries every month , among whom about 6 - 8 succumg to death (10 %)

32.15. With the removal of compulsory wearing of helmets , the frequency of helmet usage declined from 52 % in September to 14 % by February 1992.

32.16. In an opinion observation from public it was found that 88 % were in favour and 22 % against helmet use. Several reasons were given by the public for the same.

33. Fall from one level to another and fall from or out of building were the commonest mode of falls in 28.3 % and 23.7 %, followed by fall from stairs or steps in 16.2 % of head injuries. Domestic falls contributed for 67.7 % of total cases.

33.1. Height of fall was directly associated with the outcome in terms of mortality as noticed by an increase in deaths with an increase in height.

35. Assaults ( 10 % of total cases) were commonly caused by fights and quarrels between individuals , family disputes and alcohol intoxication.

36. Fall of construction objects( 32.0%), fall of household articles (20.4%) and objects falling at worksite were the major mode of injuries resulting in head injuries.

37. Only 0.7 % of head injuries were caused by industrial accidents.

38. About 32.2 % of patients were in different states of unconsciousness at the time of reaching hospital. About 87.2 % had lost consciousness immediately after the injury with a duration varying from 5 minutes to more than 3 hours.

39. Only 12 % of patients received firstaid services at or near the site of injury.

40. Haemorrhage from nose, mouth, ears and scalp was recorded in majority of cases.

41. External injuries varying from superficial skin abrasions to lacerations were found to be present in 74.8 % of total head injuries.

42. The area of head sustaining injury was commonly noticed to be frontal region, parietal region, occipital area and temporal region in 42.8 % , 21.1 % , 19.3 % , and 15.8 % respectively.

43. Seizures at the site of injury was reported by 5.1 % of head injury patients.

44. Presence of a skull fracture was found to be present in 8.0 % of total head injuries.

45. Associated long bone fracture of upper and lower limbs were documented in 14.1 % of total head injuries. Chest, abdominal and pelvic bone injuries were seen in a small number of cases.

46. About 16.0 % of head injuries were found to be severe with a glasgow coma scale of 3 - 8. Moderate and mild head injuries were documented in 10.7 % and 73.3 % of cases respectively.

47. The classification of head injuries is a complex area. Cerebral concussion, contusion and haemorrhage was documented in 51.2 % , 20.8 % and 4.3% of head injuries respectively with a combined diagnosis among others.

48. The mode of management revealed that about 19.6 % were admitted for medical management and 7.8% for surgical line of management and the rest were immediate care followed by referral to other hospitals.

49. The average duration of hospital stay for outpatient and admitted series was 4.7 (+/- 5.0 ) hours and 7.8 (+/- 9.5) days respectively.

50. The case fatality rate during hospital stay was 8.7%. About 12(0.4 %) were dead at the time of hospital entry and 26 cases had expired after their discharge from hospital (6.1 %). This provides a case fatality rate of 9.6 % in the total series.

51. At the time of follow up after an interval of 4.6 months, (n=425) about 51.8 % had totally recovered, 42.1 % were still recovering and 6.1 % had expired after their hospital discharge.

52. About 18.1 % of previously employed adults were not working and 14.4 % of children were not attending to school at the time of domiciliary visits.

53. Loss of work for a period of 60 days and 90 days was reported by 54.5 % and 34.6 % of individuals.

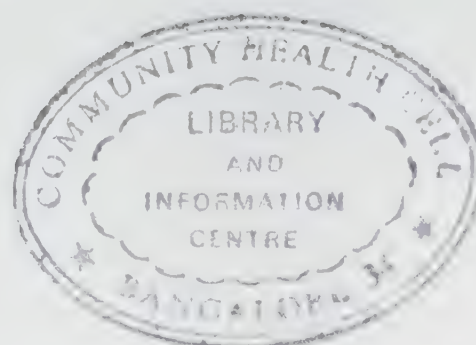
54. School attending children had lost schooling for a period of upto 60 days in 70.2 % of children.

55. Head injury sequelae was reported in majority of individuals. The commonly observed ones were post traumatic headache (25.6 %), memory problems (14.1 %), behavioural problems (12.7 %) and anxiety features in 16.9 % of total cases.

56. Speech problems , hearing problems, visual problems and locomotor problems were reported by 1.4 %, 1.4 % , 3.5 % and 5.9 % respectively.

57. Expenditure incurred by head injured individuals revealed that 44.6 % had spent an amount of more than Rs.1500 , with 9.8 % spending between Rs.6000 to Rs.15,000 and 5.7 % incurring an expenditure of more than Rs. 15,000 towards head injury care. This does not include the hospital incurred cost and also loss of income due to absence from work and the compensation amount.

Thus the present study has developed relevant information on head injuries from seven major hospitals in the city. Pooling of information from several sources was also done to develop a comprehensive data base for head injuries. This would enable concerned authorities for developing programmes in the city of Bangalore. Undoubtedly, strategies and measures in this city will be of help and an eye opener to other cities in our country and other countries.



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## 14 : RECOMMENDATIONS

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The following recommendations are placed herewith for reducing morbidity, mortality and disability from head injuries. The recommendations have been developed based on study results, experience of the attending medical professionals, opinion expressed by members of the advisory group, head injured persons and their families. We sincerely hope that these recommendations will be considered seriously by policy makers, program managers, politicians, professionals, press and public for developing the city in a more safety manner for the safety of the citizens. The suggested recommendations include both short term and longterm measures.

### 1. Policy Issues

1.1 There is need to consider head injuries and injuries as a health, socioeconomic and developmental problem. There is an immediate need to initiate National Injury prevention and Control Programme including all related sectors working on a scientific and cost effective basis to evolve suitable, appropriate and relevant programmes. National injury control programme has to be developed on a multidisciplinary integrated coordinated approach for reduction of morbidity, mortality and disability due to head injuries.

1.2. We strongly recommend the formulation of Injury Prevention Council in the city of Bangalore and other major cities. This council must have inputs from Health, Police, Industries, Road and urban development, Excise, judiciary, education, city corporation and senior administrators in all these portfolios. The head injury and injury surveillance programme will provide the requisite scientific information for this apex body to review and evaluate programmes periodically.

1.3. Government of India and State Governments must identify program officers at Central, State and District levels for networking and coordinating efforts towards injury prevention and control.

1.4. Road safety councils with appropriate funds, powers and responsibilities must become fully operational in all megacities. These councils must be coordinating bodies with multidisciplinary inputs.

## **2. Ambulance Services**

2.1 Ambulance services need to be more effective in the city. For a city of 4,183,083 individuals 162 ambulances form a meagre number amounting to roughly 1 per 25,000 population. While there is no specific standard about the number of ambulances atleast there should be one ambulance for every 8-10,000 people.

2.2. Area based ambulance services has to be planned for the city. Since ambulances are stationed in only hospitals and major centres, their availability should be planned in such a way that they are at the reach of individuals in high accident prone areas.

2.3. Ambulances has to be equipped with trained and qualified staff, first aid and resuscitation equipments, emergency medicines such that the purpose of ambulance is utilised fully.

2.4 Awareness about utilisation of ambulance services has to be increased in the public. Display boards in different parts of the city, specially on highways has to be put up. Available media like Doordarshan, press, etc. has to be fully utilised.

## **3. Emergency and casualty services:**

3.1 The casualty services in all Hospitals has to be upgraded immediately in totality. This essentially involves increase in manpower, equipment, drugs ,beds, Investigative and emergency operative facilities etc.Each hospital has to draw up individual long term oriented plans for upgrading their casualty services.

3.2. The casualty medical and paramedical personnel need to be given additional training in the management of head injury patients through short term orientation training programmes.

3.3. There is also need to appoint public relations Officer / liason officer in all hospitals. This person need to be educated about trauma care services for suitable interaction with patients, police, public, and press.

#### **4. Trauma Care Services:**

4.1. All major hospitals need to be provided and equipped with investigative and laboratory services for managing head injury victims. This would avoid referral of critically ill patients from hospital to hospital.

4.2. Suitable referral services need to be established within the city. Only those patients requiring advanced investigations and management should be referred to tertiary apex institutions.

4.3. Trauma care centres need to be established on highways at a distance of every 100 km. The district and taluk hospitals could be upgraded as integrated trauma care centres with upgraded facilities for immediate care of patients.

4.4. All hospitals and medical practitioners must provide total and immediate care for head injury patients. Awareness and education about the existing legislation must be strongly reenforced.

#### **5. Rehabilitation Services:**

5.1. Neurorehabilitation must be given importance specially for rehabilitation of head injury victims. Rehabilitation must form a part of comprehensive post trauma care services.

5.2. People should be educated and counselled about measures for reducing post head injury effects through proper followup services.

5.3. The specialised categories of manpower, equipments and supportive elements for rehabilitation must be developed in every city. There is an immediate need to develop training programmes for community based rehabilitation of head injury patients.

5.4. Apex institutions or regional centres for service, training, rehabilitation and research on injuries and head injuries must be developed in every major city.

5.5. Population based epidemiological research at community level must be undertaken to identify the magnitude, types and disabilities due to head injuries. There is an immediate need to assess the magnitude of the problem and various aspects about disabilities and handicaps among head injury patients

Since road traffic accidents are the major cause of head injuries, integrated efforts are essential for prevention of this problem.

## **6. Road planning and engineering aspects:**

6.1. Road planning has to be given utmost importance every city. Planning of new roads, expansion and maintenance of existing roads has to be undertaken on a war footing based on scientific rationale and long term planning, which would be yielding more results as compared to adhoc temporary measures.

6.2. Laying of road humps or speed breakers has to be changed. Indicators visible at all times on both sides of road humps along with marking of road humps should be placed for the safety of road users. A new design of road humps is required in the long term planning.

6.3. Proper road maintenance has to be immediately undertaken to eliminate ditches, pits, road cutters, manholes and natural obstacles.

6.4. City lights has to be improved considerably as dark roads, dark lanes and others have been found to be a major cause of road traffic accidents.

6.5. Ringroads or peripheral roads passing outside the city connecting different highways and entry points has to be planned for reducing the traffic within the city.

## **7. Traffic Control Measures:**

7.1. Traffic control measures need to evolve urgently in the city. Roads with high density of vehicles and population need to be identified and measures to reduce or diversify vehicle movements should be evolved for reducing the same. The identified areas and roads should receive immediate attention on this aspect.

7.2. Traffic safety measures must be strictly enforced in the city. Strategies towards education of the community along with strict enforcement must be developed.

7.3. Long term road planning must be developed for the city to avoid congestion, heavy traffic and accompanying effects like pollution in the city. The public transport system must be made more effective and efficient thus avoiding new entry of vehicles on the already congested roads.

7.4. Road behaviour of the users must be given due attention. Public must be educated to inculcate a sense of safety road usage behaviour to avoid head injuries

## **8. Educational and Enforcement Measures:**

8.1 Helmet wearing must be made compulsory for drivers and passengers of two wheeler engine vehicles. Information on helmets must be available to vehicle buyers at the time of purchase or insurance explaining the role and importance of helmets. Education on this aspect must be incorporated in schools, colleges, inservice training programmes, industries and other ongoing training programmes.

8.2. Alcohol consumption and driving has to be tackled immediately through education and enforcement measures. Random checkings for alcohol and drunken driving with heavy penalties for drunken driving should be enforced. Education of all categories of road users and other sections of community has to be given topmost importance in this aspect .

8.3. Overspeeding and overtaking should be strictly banned on highways and major roads with measures for speed control being strictly enforced. Implementation of speed limits in and out of cities and towns should be strictly enforced.

8.4. Use of protective equipments like headgear should be encouraged at worksite, playsite , contruction site and others.

8.5. Community must be educated through available media and other channels about safety precautions at home,work place ,industrial establishments . Simple safety technologies must be developed for this purpose with application in design,layout, construction and regular use.

8.6. People should be educated about the harmful effects of violence and assaults. Educational efforts in colleges, schools and other places must be increased. People must be discouraged about the harmful use of instrtuments.

8.7. Education on first aid services must form a part of curriculum in schools , colleges, and any inservice training programmes of police, industrial workers and health workers. Simple illustrative manuals in all regional languages must be published to enable trainers.

8.8. First aid services and training must be a part of learning in all the driving schools. Issue of driving licences must examine this while certifying potential learners.

8.9. Special use of media like Television, Press, newsletter, pamphlets and others must be employed in spreading first aid knowledge to communities for understanding the basic components of first aid services.

8.10. Public should be encouraged to utilise ambulance services for early transportation of victims. Information on this should be available through media. A simple directory of ambulance services must be published for the city of Bangalore and other megacities.

8.11. Education is also vital in educating the public about proper maintenance of vehicles in good condition.

8.12. Education on following traffic safety norms and rules should be given to public. Specially to avoid overspeed, overtaking, sudded crossing, cautions during road cross, pedestrian road practices and other issues.

8.13. Educational materials in all local languages should be developed and used regularly especially in schools, colleges, driving schools ,industries, and any other refresher or inservice training programmes of health ,police, etc.

## **9. Surveillance on Head Injuries:**

9.1. Head injury and Injury Surveillance must be initiated in the in the city of Bangalore. To begin with NIMHANS, SGARC, along with the departments of Police , Industries and road development must be involved. This activity could be expanded to include other institutions, thus becoming a permanent activity in the city .

9.2. Since NIMHANS is the major centre for the management of head injuries a comprehensive database must be established on all aspects on head injuries.

## **10. Research:**

10.1. Increased budgetary allocations must be made on research towards prevention of head injuries due to various causes specially road traffic accidents. Activities in this area should include epidemiological, sociological, behavioural, environmental safety, design and quality control along with related aspects.

10.2. Research on assessing the current levels of knowledge, attitude and practice towards head injury prevention and control should be undertaken specially among the youth, college going students, industrial workers and public.

10.3. Needs assessment for rehabilitation must be undertaken. This should aim at assessing the needs and available facilities in terms of manpower, supportive facilities and mechanisms of developing community based services.

10.4. Similar studies on the problem of head injuries and injuries should be undertaken in other cities with the joint participation of medical colleges, government health and related agencies, non governmental organisations, police, industries and others.

10.5. Research on head injury diagnosis, classification and coding must be undertaken with a view to evolve simple mechanisms for application in developing countries. Suitable modifications might be required with ICD 10 in some situations.

## **11. Training:**

11.1. There is an immediate need to develop training programmes at different levels. For the administrators and decision makers there is a need to evolve sensitising and orientation programmes. There is also a need for incorporating injury and head injury prevention and management in school, college and undergraduate medical curricula at various levels.

11.2. All the Medical Officers in casualty, general wards and district hospitals must be given orientation and training in head injury management and referral services.

11.3. There is a need for interdisciplinary joint training programmes for doctors, nurses and allied personnel in Surgery, Orthopaedic Surgery, Neurosurgery and Plastic Surgery on comprehensive Injury management.

## **12. Community Participation:**

12.1. Community participation in injury prevention and control should be encouraged and strengthened. This would enhance the role of local communities to identify, plan ,implement and evaluate programmes.

12.2. The local Non-governmental organisations must be encouraged to take up head injury prevention and control, education and rehabilitation as part of their activities

#### **14.1 IMMEDIATE MEASURES**

1. There is an immediate need to formulate an Injury prevention council in the city of Bangalore to develop an action plan towards prevention of injuries and head injuries. This council must consist of senior decision makers and implementing authorities from Health, Police, Transport, Judiciary, Education, Information and Broadcasting, Industries, Road safety, city corporation, Voluntary agencies and others with adequate powers and responsibilities for joint action in an integrated and coordinated manner.

(Attn : Govt. of Karnataka and city corporation)

2. The emergency services must be fully strengthened in all the government hospitals with adequate manpower, beds, investigative facilities treatment facilities.

(Attn : Directorate of Health services)

3. The medical and paramedical personnel in all hospitals must be given orientation and training in management and referral of head injury and injury patients

(Attn : Directorate of health services and NIMHANS)

4. Helmet wearing must be made mandatory for all engine driven two wheeler drivers and pillions with immediate effect by modification of the existing legislation.

(Attn : Ministry of Transport)

5. Alcohol and driving must be strictly banned in all places. A combination of education and strict enforcement is required to acheive this goal. Increased checkings with heavy penalties for drunken driving should be enforced. Education of all categories of road users must be undertaken on a war footing immediately .

(Attn : Department of Police, Law, Information & Broadcasting)

6. Public education on road traffic safety, road traffic norms, road safety procedures, helmet wearing, alcohol and driving, First aid services, harmful effects of alcohol due to falls/violence, proper vehicle maintenance must be initiated immediately to prevent head injuries. The education must focus on modifying the behaviour and practices of road users.

(Attn : Departments of health, Police, Information & broadcasting)

7. Integrated trauma care centres must be established on all the highways (at a distance of 100 kms ) and in major government hospitals. The district and taluk level hospitals could be considered for this purpose with upgrading in requisite areas.

(Attn : Department of health & Directorate of health services)

8. Immediate attention in road planning by concerned authorities in high accident prone areas and black spots is required. Laying of road humps or speed breakers must incorporate placing of visible indicators along with markings for " seeing " and " be seen " purposes.

(Attn : City corporation and Department of Police)

9. Proper organisation of ambulance services in terms of availability, facilities , awareness and utilisation has to be undertaken. Area based ambulance services ( with easy availability in high accident areas ) must be planned.

(Attn : Department of Health and Directorate of health services)

10. Training on first aid services to police, drivers, school and college students and to paramedical workers is an activity to be undertaken immediately. Wherever initial training has been provided periodical refresher courses are essential for reinforcement of knowledge and skills.

(Attn : Departments of Police, Transport, Health & St. Johns's ambulance association)

11. The local non governmental agencies must be encouraged and promoted to participate in head injury and injury prevention activities. Initially about five organisations must be identified and trianed for this purpose. These agencies could be given the tasks of education,counselling ,first aid services,accident research and evaluation .

(Attn : Departments of health and police & Voluntary agencies)

12. Research at both community and hospital levels on rehabilitation needs vis a vis avilability,problem of head injuries (incidence, morbidity,mortality and disability), aetiology, behavioral aspects, disabilities, surveillance is required for development of information in vital areas.

(Attn : NIMHANS and department of Police)

## 15. REFERENCES AND SUGGESTED READING

1. World Health Organization : Research Development for Accident and injury prevention : 1985.
2. World Health Organization: Road traffic accidents in developing countries: Technical Report Series 703, 1984.
3. Sally K. Stansfield, Gordon S. Smith and William McGreevy: Injury: Disease Control Priorities in developing countries. eds (D.T. Jamison & W.H. Mosley). Population, Health & Nutrition Division, World Bank, June 1990.
4. Shrikant Bangdiwala & Elias Anzola - Perez : The Incidence of Injuries in young people : II Log Linear Multi variable models for risk factors in a collaborative study in Brazil, Chile, Cuba and Venezuela. International Journal of Epidemiology, 19 (1), 125-132, 1991
5. World Health Organization: Program advisory group on accident prevention : 1986.
6. Doris Storms : Data sources and Injury Epidemiology in: World Health Organization: Principles for Injury Prevention in developing countries, 1985.
7. Anne Tursz : Epidemiological studies of accident morbidity in children and young people , Problems of methodology : World Health statistics quarterly vol, 39(3), 257 - 267, 1986.
8. World Health Organization : Community prevention of accidental injuries in childhood : from knowledge to action : manual for community paediatricians and maternal and child health teams, 1987.
9. Directorate General of Health services. Central Bureau of Health Intelligence : Health Information India 1989. Government of India, Nirman Bhavan, New Delhi, 1989.
10. Dinesh Mohan - Accidental death and disability in India : A Stocktaking : Accident analysis and prevention 16(4) 79-88, 1984.

11. Srinivasan NS: Accident prevention and Trauma care management, National Transportation planning and research centre, Trivandrum, 1987
12. Park & Park : Text book of Preventive & Social Medicine, Banarasi Das Publications, 1988.
13. Rao C J, Mohanty S & Mukherji K S : Epidemiological features of head injuries around varansi : Proceedings of the 26th annual conference of Neurology Society of India, 1976.
14. Kalayanaraman S, Head Injuries in children Neurology India vol. 25(2), 95-107, June 1977.
15. Natarajan H. Adjustmental Problems of Head Injured patients, ICMR study report, 1987.
16. Tandon P.N. Management of Head Injury, facts fashions & facts, Neurology India, 34,1-30,1986.
17. Pathak L.R., Renjhen R.C. & Mitra A : Followup of 2190 cases of Head Injury : Neurololgy India, 356-359,1972.
18. Ramamurthy B - Twilight areas in the management of head Injuries, Neurology India, vol. 25, (2), 143-146B ,1977.
19. World health organization : Major issues in road traffic accidents in developing countries ,1981
20. Dorothy P. Rice, Ellen J. Mackenzie and associates cost of injury in the United States : A report to congress. San Fransisco, CA : Institute for health and aging, University of California and Injury Prevention Center, The John Hopkins University, 1989.
21. Ljudmila Pavlovna Grigorovic : Injuries to children can be avoided : World Health Forum Vol. 9, No.4, 595-599 ,1988.
22. Sobha Nambishan : Director of Census Operations, Karnataka : Census of India 1991 : Provisional population tables. Karnataka Series 11.

23. Personal communication : Transport department, Govt of Karnataka, Bangalore
24. Personal communication : Police department, Govt of Karnataka, Bangalore.
25. Mohan D S et al : Road traffic accidents in Bangalore. Karnataka State Council for Science & Technology 1987.
26. Gururaj G : Preliminary Observations on head injury victims at NIMHANS. Paper presented at the fourth annual conference of Karnataka association of community health Dec.1989.
27. Gururaj G, Satischandra P, Banejee D & Subbakrishna D K; Factors contributing to mortality from head injuries in India. Paper presented at the regional scientific meeting of IEA 1991, Bali, Indonesia.
28. Dean AD, Dean JA, Burton AH, Dicker RC. Epi info, version 5 : a word processing, database and statistics program for epidemiology on micro-computers. USD, incorporated, Stone mountain, Georgia, 1990.
29. Ann Taket : Accident mortality in children, adolescents and young adults : World Health Statistics quarterly 39(3), 232 - 256, 1986.
30. Michel Manciaux & Claude J Romer : Accidents in children, adolescents and young adults : A major public health problem : World health statistics quarterly, 39, 227 - 231, 1986.
31. Dinesh Mohan : Disability and Rehabilitation In : World Health Organization : Principles for Injury Prevention and Developing Countries : 1985.
32. Kraus, J.F., Black, M.A., Hewssol, N., Ley, P., Rokaw, W., Sullivan C, m Bowers, S., Knowlton, S., and Marshall, L., The incidence of acute brain injury and serious impairment in a defrined population. American journal of epidemiology, 119, 186-201, 1984.
33. Annegers, J.F., Grabow, J.D. Kurland I.T. and Laws, E.R., Jr. The incidence causes and secular trends of head trauma in Olmsted County, Minnesota, 1935-1974, Neurology, 30, 912, 1980.

34. Klauber, M.R., Barrett-Connor, E., Marshall, L.F., and Bowers S.A. The epidemiology of head injury: a prospective study of an entire community, San Diego County, California, 1978, American Journal of Epidemiology. 113,500, 1981.
35. Jennett, B, and Teasdale, G., Management of Head Injuries. F.A. Davis, Philadelphia, 1981, 77.
36. Cooper, K.D., Tabaddor, H, Hauser, W.A. Shulman, K., Feiner, C., and Factor. P.R., The epidemioilogy of head injury in the Bronx, Neuroepidemiololgy, 2,70, 1983.
37. Jennett, B and MacMillan, R., Epidemiology of Head Injury, British Medical Journal, 282, 101, 1981.
38. Edna, T.H. and Cappelen, J., Hospital-admitted head injury: a prospective study in Trondelag, Norway, 1979-80, Scand.J. Soc. Med., 12,7, 1984.
39. Fife, D., Faich, G., Hollinshead, W., and Boynton, W., Incidence and outcome of hospital-treated head Injnury in Rhode Island, American Journal of Public Health, 76, 773, 1986.
40. Nestvold, K., Lundar, T., B likra, G., and Lonnum, A., Head Injuries during one year in a central hospital in Norway : a prospective study: Epidemiologic features, Neuroepidemiololgy, 7, 134, 1988.
41. Laurence Tiret et al : The Epidemiology of Head Trauma in Aquitaine (France ), 1986 : A Community based study of hospital admissions and deaths : International Journal of Epidemioilogy 19(1), 1990.
42. Sambasivan M. Survey of the problems of Head Injuries in India. Neurology India, vol. 25(2), 51-59 ,1977.
43. Dhingra N et al : Accident and injury prevention at the primary health care level , Proceedings of the xviii conference of IAPSM, 1988
44. Jess F. Kraus : Eppidemiologic features of Injuries to the Central Nervous System . In : Neuroepidemiology A tribute to

Bruce Schoenberg : eds : Dallas W. Anderson & Devera G. Schoenberg  
: CRC Press : 1991.

45. Daniel M. Sosin, Jeffrey J. Sacks, Patricia Holmgren: Head Injury - Associated deaths from Motorcycle crashes Relationship to helmet - use laws. Journal of American Medical Association, 264 (48), 2395-2399, 1990.

46. Osberg J.S., Di Scala C : Morbidity among motor vehicle crash victims : The effectiveness of seat belts. American journal of Public Health, 82(3), 422-425, 1992.

47. Dinesh Mohan and K.P. Kothiyal : Helmet and head injury study of crash involved motorcyclists in Delhi ( Unpublished ).

48. Ramamurthy B, & V. Ramaswami : Psychological damage after head injury in children and adults. Neurology India, Supplement II, December 1972.

### 16.1. Annexure I LIST OF FIGURES

- 1 : Growth of motor vehicles in India during 1971-1983.
- 2 : Number of Motor Vehicles in Bangalore during 1985-1992
- 3 : Injuries and deaths in Bangalore.
- 4 : Location of study centres.
- 5 : Time of Occurrence of head injuries.
- 6 : Age - Sex distribution of head injury morbidity.
- 7 : Age - Sex distribution of head injury mortality.
- 8 : Alcohol among adolescents as a risk factor.
- 9 : Interval between alcohol consumption and head injury.
- 10 : Cause of head injury morbidity and mortality.
- 11 : Mode of arrival
- 12 : Highway distribution of road accidents.
- 13 : Responsible vehicle for head injury.
- 14 : Place of occurrence of falls.
- 15 : Epilepsy and Head Injuries.
- 16 : Severity of Injury as per glasgow scale.
- 17 : Prevention of head injuries and sequelae

## **. Annexure II LIST OF TABLES**

1. Registered vehicles in the city of Bangalore.
2. Profile of study centres.
3. Distribution of Injuries.
4. Age-Sex distribution .
5. Cause of Injury.
6. Injuries as per day of occurrence.
7. Injuries as per time of occurrence.
8. Mode of arrival.
9. Incidence of head injuries.
10. Age - Sex distribution of head injuries.
11. Educational Status.
12. Occupational Status.
13. Family Income.
14. Alcohol related head injuries in the study population.
15. Alcohol related head injuries among adolescents.
16. Alcohol and cause of head injuries.
17. Associated comorbid conditions
18. Cause of head injuries.
19. Mode of arrival and cause
20. Day of head injury occurrence.
21. Time of Occurrence and cause of head injuries
22. Place of occurrence of head injuries.
23. Interval between injury and medical contacts.
24. First aid services.
25. Source of first aid services.

26. Source of referral.
27. Expenditure incurred till reaching study hospital.
28. Location of road accidents.
29. Highways and road traffic accidents.
30. Geographical distribution within the city.
31. Mode of road traffic accidents.
32. Status of person at the time of injury.
33. Human factors.
34. Environmental Problems.
35. Combined Factors.
36. Status of person and alcohol consumption
37. Status of Protective Equipments.
38. Helmet wearing and outcome.
39. Monthwise distribution of injuries and deaths among helmet wearers and non wearers.
40. Public Opinion on helmets.
41. Mode of fall.
42. Relation between height of fall and outcome.
43. Reasons for Assault.
44. Nature of objects causing head injuries.
45. Level of consciousness immediately after head injury and at hospital entry.
46. Duration of unconsciousness.
47. Associated injuries with head Injuries.
48. Skull fracture and head injuries.
49. Nature of head injuries.
50. Mode of management.

51. Duration of hospital stay.
52. Outcome at the end of hospital stay.
53. Opinion on quality of services.
54. Current health status.
55. Absenteesmm due to head injury and sequelae.
56. Sequelae from head injury.
57. Cost of head Injuries to the families.
58. Suggestions by patients for prevention and improving care
59. Incidence of head injuries
60. Causes of head injuries .



# NATIONAL INSTITUTE OF MENTAL HEALTH & NEURO SCIENCES : BANGALORE

## EPIDEMIOLOGY OF HEAD INJURIES

(Sponsored by KSCST, BANGALORE)

1. Sl. No.

2. Neuro No.

3. Casualty No.

4. Place of registration  
(Code from 1-8)

5. Date of registration

6. Time of registration

7. Information collected from :

Patient (1) /Relative (2) /Friend

(3) Attendant (4) / Police

(5) Medical records (6) Multiple sources

(7) Unknown (8)

### SOCIO-DEMOGRAPHIC INFORMATION

8. Name of patient .....

9. Age (in years)

10. Sex :

Male (1) / Female (2)

11. Address of patient

(Residential) .....

.....

.....

.....

Tel No.

12. Place of occupation.....

.....

.....

.....

Tel No. (if employed)

## 13. Religion :

Hindu (1) / Muslim (2) / Christian (3)  
/ Others (4)

☐

## 14. Educational status :

Illiterate (1) / Primary (2) / Secondary  
(3) / High School (4) / Junior College  
Pre-University (5) / Graduate (6)  
/ Post Graduate (7) / Professional  
(8) / Not applicable (9) / Not known  
(10)

☐ ☐

## 15. Occupation :

Agriculturist (1) / House wife  
(2) / Clerical (3) / Teachers  
(4) Students (5) / Business  
(6) / Labourer (7) Factory Employee  
(8) Professional (9) / Retired  
(10) / NA (11) / Specify .....  
(12) NK (13) / Others  
(Code as per manual)

☐ ☐

## 16. Family Income :

(in rupees per month)

☐ ☐ ☐ ☐ ☐

## 17. Family size :

☐ ☐

## 18. Marital status :

Single (1) / Married (2) / Divorced or  
Separated (3) / widow (er) (4) / NK  
(5)

☐
PERSONAL INFORMATION :

19.

Present (1) /  
Absent (2)

Duration  
(in month)

a. Smoking

☐
☐ ☐ ☐

b. Consumption of Alcohol

☐
☐ ☐ ☐

c. Consumption of drugs like

Barbiturates (1) / Cannabis  
(2) / Heroin (3) / Sedatives (4) / Opium  
(5) / Others (6) / Specify.....

☐
☐ ☐ ☐

20. Did you consume Alcohol/drugs  
Prior to the occurrence of Head  
Injury - Yes (1) / No (2)

☐

No. of hours prior to occurrence :

☐ ☐

21. Has this been entered in Medical records ;  
Yes (1) / No (2) / NA (3)

☐

22. Has this been entered in Police records  
Yes. (1) / No (2) / NA (3)

☐

23. Presence of Physical/Mental illness in the victim (To be ascertained with documents/records depending upon availability)

Present (1) / Absent (2)

Treated (1) / Untreated (2)

Duration in Yrs

A. Hard of hearing

☐
☐
☐
☐

B. Visual problems

☐
☐
☐
☐

C. Physical disability

☐
☐
☐
☐

D. Diabetes Mellitus

☐
☐
☐
☐

E. Hypertension

☐
☐
☐
☐

F. Epilepsy

☐
☐
☐
☐

G. Mental retardation

☐
☐
☐
☐

H. Mental illness

☐
☐
☐
☐

I. Congenital deformities

☐
☐
☐
☐

J- Others, Specify

☐
☐
☐
☐

24. Did you meet with Head Injuries Previously ? Yes (1) / No. (2)

☐

If yes, how long back (in years)

☐
☐

### INJURY INFORMATION :

25. Mode of arrival :

Ambulance (1) / Personal transport  
(2) / Public transport (3) / Other (4)  
Specify

☐
☐
☐
☐
☐
☐
☐

26. Date of occurrence of Head Injury

☐

27. Day of occurrence of Head Injury  
(Code from 1-7)

28. Time of occurrence of Head Injury

☐
☐
☐
☐

29. Place of occurrence of Head Injury.  
Road (1) / Industrial (2) Construction  
(3) / Domestic (4) / Playsite  
(5) / Agricultural (6) Others  
(7) / Not known (8)

☐

Address : .....

Tel. No.

30. Cause of Head Injury:

Road traffic accident (1)/Domestic fall(2)/  
industrial Accident (3) /Assault (4) /  
Hit or fall by an external object (5) /  
Injury due to fire arms (6) /Others (7)  
(Proceed to appropriate sub-sections  
33-37)

31. Time interval between occurrence of  
Injury and first medical contact : [in hrs]

32. Time interval between occurrence of  
injury and reaching definite hospital(in hrs)

33. Road traffic ACCIDENTS ;

33.1 Mode of Injury : (Code as per manual)

Reasons as informed by victim :

1.

2.

3.

33.2 Type of Vehicle Involved (28.3)

Bicycle (1) / Moped (2) / Scooter  
(3) /Motor bike (4) /car (5) /Jeep  
(6) /Matador (7)/ bus (8) /lorry  
(9) /Others (10)/ specify

33.3 Status of injured person at the time of  
accident :

Driver of motor vehicle other than  
Motorcycle (1) passenger in motor vehicle  
Other than motor cycle (2) motor cyclist  
(3) Passenger on motor cycle  
(4) Pedal cyclist (5) Pedestrian  
(6) stationary individual  
(7) Others specify (8)

33.4 Were you wearing any protective  
equipment

at the time of accident :

Yes (1) / No (2)

34. Domestic fall/Accidental fall/Fall due  
to other causes.

34.1 Nature of fall

Fall from stairs or steps (E890) /  
Fall from Ladder (E881) /Fall from or out  
of building (E882) / Fall in to hole or  
other opening in surface (E883) Fall on  
same level (E884) / Fall on same level  
due to collision/pushing (E886//)  
Accidental fall (F888)

## 34.2 Reasons for fall :

Intentional (1) /Unintentional  
(2) /Environmental (3) /

☐

Reasons as informed by victim

a.

b.

c.

## 34.3 Height of fall in feet.....

☐

## 34.4 Nature of landing surface :

Hard (1)/ Loose Earth (2)/Soft  
(3) /Sharp (4)

☐

## 34.5 Anatomical part of Head, hitting the surface :

Anterior part of Head, (1) /Posterior  
part of Head (2) /Rt. lateral part of Head  
(3)/Lt. Lateral part of Head (4)/ Vertebral  
column (5)/other area's specify.....

☐

## 35. ASSAULT

## 35.1 Type of Assault :

Assault by cutting and piercing  
instrument (E920) Assault by other  
means(E968), specify.....

☐

## 35.2 Site of injury :

Anterior part of Head (1) /Posterior part  
of head (2)/ Rt Lateral part of head (3) /  
Lt. lateral part of head (4) /  
Vertebral column (5) /others  
(6) /Specify.....

☐

## 36. FALL OF AN EXTERNAL OBJECT :

## 36.1 Nature of object.....

## 36.2 Mode of fall

Accidental fall of an external object  
(E916)/ Others specify.....

☐

## 36.3 Area of fall

Anterior part of head 1 / Posterior part  
of head (2) / Rt. lateral part of head (3) /  
Lt. lateral part of head (4) / Vertebral  
column (5) /Others (6) .....

☐

## 36.4 Height of fall in feet.....

☐

## 37. Industrial accident :

## 37.1 Mode of accident :

Accidental fall at work site (1) /

Hit by a moving object (2) /

Hit with a stationary object (3) /

Environmental problems (4)

Specify.....

☐REFERRAL INFORMATION ;

38. Was any first aid services administered at the site of accident.

Yes (1) /No (2)

☐

39. If yes for 37, by whom :

Doctor (1)/Health worker (2) /Family

members (3) Public (4) / Others (5)

☐

40. Source of referral :

General practitioner (1) /Nursing home

(2) /Govt- Hospital (3) /Private teaching

hospital (4) /SGARC (5) /Private

non-teaching hospital (6) / Directly (7) /

PHC (8) /Others (9) Specify.....

☐

41. Approximate cost incurred till reaching definitive hospital (in rupees)

CLINICAL INFORMATION

42. Status on arrival :

Conscious (1) /Response to stimuli (2)/  
unconscious (3) /Dead (4)☐

43. Level of consciousness immediately after the occurrence of head Injury

Fully conscious & Oriented (1) /drowsy  
but arousable (2) /Stuporous (not  
arousable) (3) /Unconscious (4) /not  
known (5)☐44. Duration of unconsciousness,in hours/  
minutes

hrs.

Mins.

45. Loss of memory (Amnesia) after head injury :

Present (1) / Absent (2) /Not known (3)

☐

If yes : Antegrade (1) / Retrograde (2)

☐

46. Blending immediately after head injury  
Present (1) / Absent (2) NK/ (3)

Nose

Throat

Ears

Scalp

47. C. S. F. leak after head injury  
Present (1) / Absent (2) / NK (3)

Nose

Ear

Throat

48. Seizures/fits immediately after injury :  
Present (1) / Absent (2) / N.K. (3)

49. No. of seizures

50. External Injury :  
Abrasion (1) / Laceration (2) /  
Multiple Superficial Injuries (3) /  
Multiple deep injuries (4)

51. Anatomical site of Injury :  
Present (1) / Absent (2) /

Frontal

Parietal

Temporal

Occipital

Posterior fossa

52. Presence of Skull Fracture :  
Present (1) / Absent (2)

Linear

Depressed

Compound depressed

Multiple fractures

53. Associatiated Injury :  
Present (1) / Absent (2)

Neck Injury

Chest Injury

Abdominal Injury

Crush Injury

Injury to Pelvic bones

Injury to long bones

## 54. Glasgow coma scale

Best eye response

☐

Best motor response

☐

Best verbal response

☐

Total score

☐

## 55. Nature of Head Injuries :

Diffuse (1) / Localised (2) / Unspecified (3)

Concussion

☐

Contusion

☐

Haemorrhage

☐

Unspecified

☐

## 56. Final diagnosis .....

## 57. ICD Code

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

## 58. NIMHANS Code

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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## MANAGEMENT INFORMATION :

## 59. Treatment in casualty and sent home (1) /

Treatment in casualty and observation (2) /

☐

Treatment in casualty and referred to other hospital (3)

Treatment in casualty and referred to NIMHANS (4)

Admission and conservative management (5)

Admission and surgical management (6)

Referred to another hospital (7)

Referred back to same hospital (8)

## 60. Duration of hospital stay :

In days

<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------

In hours

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------

## 61. Final status :

Complete improvement (1) / Partial-improvement (2) / Minimum improvement (3) / Unchanged (4) / Referred (5) /

Improved &amp; referred (6) /

unchanged &amp; referred (7) / Death (8)

☐

## 62. Investigator's code

☐

Signature of Investigator

## 16.4 PROFORMA II

1. Date of Interview \_\_\_/\_\_\_/\_\_\_
2. Interval of follow up \_\_\_\_\_
3. Neuro No \_\_\_\_\_
4. Present health status \_\_\_\_\_
  - 4.1. Fully recovered
  - 4.2. Partially recovered
  - 4.3. Not recovered
  - 4.4. Death after hospital discharge
5. Mobility status \_\_\_\_\_
  - 5.1. Independent
  - 5.2. Dependent
6. Present working status \_\_\_\_\_
  - 6.1. Full return to previous job
  - 6.2. Part time return to previous job
  - 6.3. New job
  - 6.4. Not working
  - 6.5. Not applicable
  - 6.6 Not known
7. Present schooling status \_\_\_\_\_
  - 7.1. Partial return to school
  - 7.2. Not going to school
  - 7.3 Not applicable
  - 7.4 Not known
8. Loss of work/school in days \_\_\_\_\_

9. Current source of income \_\_\_\_\_

9.1 Earlier job

9.2 Compensation

9.3 Paid sick leave

9.4 Family income

9.5 None

10. Opinion on care during hospital stay.

10.1 Service : Satisfactory (1) /  
Un satisfactory (2) / Not known (3) \_\_\_\_\_

10.2 Referral : Required (1) /  
Not required (2) / Not known (3) \_\_\_\_\_

10.3 Education : Provided (1) /  
Not provided (2) / Not known (3) \_\_\_\_\_

11. Reception at the hospital \_\_\_\_\_

Good (1) / Moderate (2) / Bad (3)

Not known (4)

12. Approximate amount spent on hospital care

Rs. \_\_\_\_\_

13. Contact with other health agencies after  
examination at definitive hospital \_\_\_\_\_

Yes (1) / No (2) / Not known (3) /  
Not applicable (4)

If yes , specify \_\_\_\_\_

14. Illness following head injury

1 Present 2 Absent

14.1 Locomotor disability \_\_\_\_\_

14.2 Post traumatic epilepsy \_\_\_\_\_

14.3 Loss of Memory \_\_\_\_\_

14.4. Behavioural problems \_\_\_\_\_

14.5. Anxiety features \_\_\_\_\_

14.6 Post traumatic headache \_\_\_\_\_

14.7. Otorrhea \_\_\_\_\_

14.8. Rhinhorrea \_\_\_\_\_

14.9. Speech Problems \_\_\_\_\_

14.10. Visual Problems \_\_\_\_\_

14.11. Others, specify \_\_\_\_\_

15. What are your suggestion towards improving hospital care

1.

2.

3.

4.

5.

16. What are your suggestions towards prevention of head injuries

1.

2.

3.

4.

5.

## 16.5 : THE ADVISORY GROUP

Dr.S.M. Channa Basavanna  
Chairman  
Director  
NIMHANS  
Bangalore

Dr. G. Gururaj  
Project Officer  
Associate professor  
Dept. of Epidemiology  
NIMHANS

Dr. B.S. Das  
Professor and Head  
Dept. of Neurosurgery  
NIMHANS

Mr. Ramalingam  
Director General of Police  
Nrupathunga Road  
Bangalore

Mr. C. Dinakar  
Addl. Director General of Police  
and Commissioner for Traffic and  
Road safety  
Nrupathunga Road  
Bangalore

Mr. M.N. Reddy  
Deputy Commissioner of Police  
(Traffic)  
Bangalore

Mr. A.R. Infant  
Deputy Commosioner of Police  
(Traffic)  
Bangalore

Mr. S.K. Shivanada  
Commissioner for Transport  
Bangalore

Mr. Shyam Bhat  
Transport Department  
Bangalore

Mr.B.S. Pai  
Secretary  
Karnataka State Cou  
for Science & Techn  
Bangalore

Dr. P.Nagaraja Rao  
Additional Director  
Sanjay Gandhi Accid  
Relief Complex  
Bangalore

Mr. Rajagopalan  
Executive Secretary  
KSCST  
Bangalore

Mr.K.S.Vasudeva Mur  
Secretary  
Karnataka State Leg  
aid board  
Bangalore

Dr.C.E.Justo  
Professor  
Civil Engineering  
department  
Bangalore Universit  
Bangalore

Mr. Aradhya  
Inspector of Police  
Bangalore

Mr. Mohanram  
Systems analyst  
KSCST  
Bangalore

Dr.. Annigere  
Chief health Office  
City Corporation  
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